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INDEX

THE
BRASS WORLD
AND
PLATERS' GUIDE



VOLUME XI
1915

JANUARY TO DECEMBER
(INCLUSIVE)

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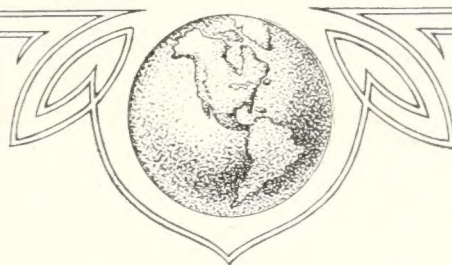
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The Brass World & Platers' Guide

BRIDGEPORT



CONNECTICUT

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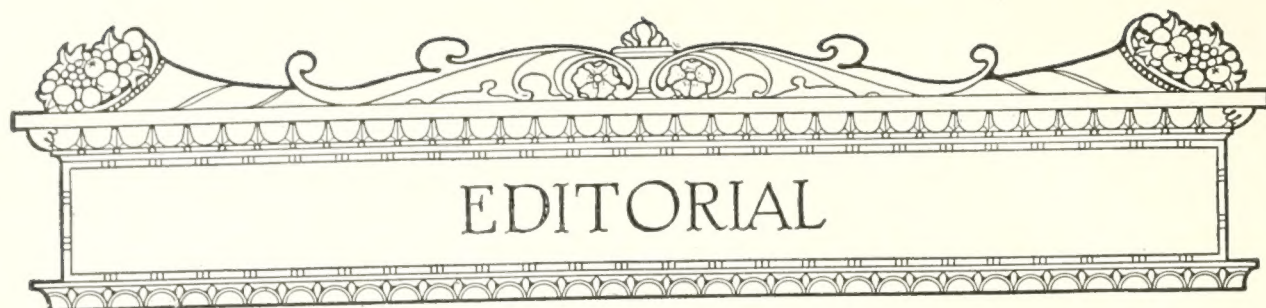
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TILLING AN ACRE OF TIME.

The years of our lives may be compared to acres of time. Unlike land acres, we can only work our yearly acres one at a time, having however the same advantage as the agriculturist that careful working and attention insures success in future efforts.

In the old Roman days, each citizen was allotted two acres for his own maintenance. The ushering in of the year 1915 has brought each one of us an acre of time, untilable by any one else, which cannot be sold or mortgaged and from which we are left to reap the harvest proportionate to our skillful tilling.

The wise worker of the soil ploughs and cross-ploughs his field and the finished surface after seeding shows an evenness which delights the eye. No deep ruts are visible. The farmer has planned his plowing; what we see is the result of the plans carried out to perfection.

The working of time acres is too often marred by the presence of ruts. The New Year period has been dedicated by man to the forming of plans and the making of resolutions, only a few of the latter escaping the fate of the ten commandments. There is still desire in most people's minds to make at least one resolution which may be kept and if we wished to put one in writing which could be profitably made and kept by us all it would read:—

"I will get out of the ruts I made in 1914."

Few of us escape falling into rutty ways during a year of routine. Many of us have yet to realize the depth of the ruts we have travelled in if, indeed, we have become conscious of their existence. A rut impedes freedom of action and is a barrier to the exercise of initiative. How can we till our acre of time fully to profit if the wheels of effort drag in the ruts of habit? Most lack of suc-

cess credited to bad luck can be ascribed to mental slothfulness or "rutting."

In the office of a large factory, a clerk came to his employer and said "I have a complaint to make. I have served you faithfully and well for fifteen years. On the death of Thompson last week, you gave his position to Boyd, who has only been here three years. That position was mine by right of good and lengthy service."

A rumbling was heard outside. The boss said "Jim, before I consider your case, go outside and tell me what is causing that racket."

Jim returns. "Some big wagons going down the street."

Boss: How many are there?

Jim: I'll go and see. (Returning) Eight.

Boss: What a noise they make. I wonder what's in them.

Jim: I don't know but I'll find out. (Returning) They're full of wheat.

Boss: I wonder where they came from?

Jim: I don't know but I'll ask. (Returning) They came from Wheeling.

Boss: Where are they going, do you think?

Jim: I'll ascertain. (Returning) They are going to Steubenville.

Boss: Send Boyd here. (Boyd enters) Boyd, find out what is making that racket outside.

Boyd leaves without comment, is absent two minutes and returns.

Boyd: Eight wagons, loaded with wheat from Wheeling and going to Steubenville. (Boyd departs).

Boss: It is true, Jim, you have served me faithfully for fifteen years but you have not served yourself as well. You took five trips to notice what Boyd discovered in one. Do you wonder at his promotion? My boy, you are in a rut.

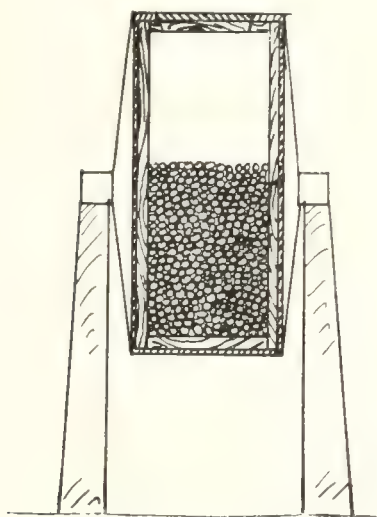
Let us avoid ruts as much as possible, remembering that our 1914 acre can never be harvested again.

THE POLISHING OF METAL GOODS BY THE BARREL METHOD.

There has been so much interest manifested during the past 12 months in the best methods of obtaining the most efficient results in polishing metal goods by the barrel method that a review of the history of this practice will be appreciated by our readers. No one knows who invented the barrel. It was probably the development of ages, taking its shape from the efforts of savages to create permanent cooking utensils and water containers. The first cooking utensils were hollow gourds, cocoanut shells, etc. These were placed on the early camp-fires for cooking purposes, but had the disadvantage of burning up

off scale from metal goods in this process. It was observed that the parts in constant tumbling contact became brightened by the operation. To assist the removal of scale in irregular pieces, small cubes of iron or steel of different dimensions were used to reach the deepest and narrowest parts and, to quicken the action, liquids of different kinds and abrasives were introduced. The knowledge of this successful practice spread to other industries and different applications of the idea were made.

In 1876, a book entitled "British Manufacturing Industries", by Edward Standford, de-

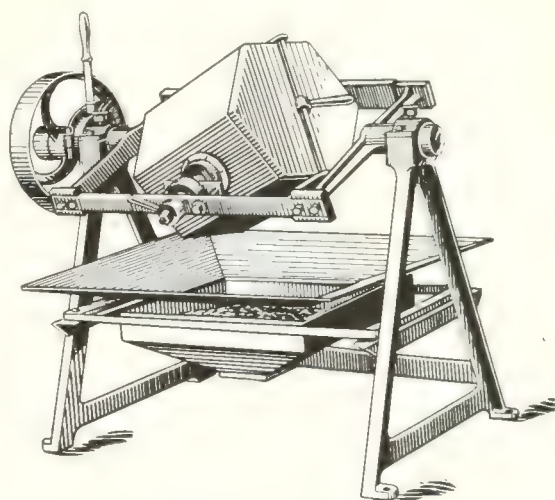


Early Type of Barrel.

rapidly. Man's ingenuity (or was it woman's?) suggested the protection of the gourd or shell with a coating of clay. It was then found that the clay became baked by repeated firing and was capable of being used as a cooking pot without the gourd interior or lining. People learned then how to build up pots from clay in various sizes and shapes according to camp requirements and the barrel form was soon imitated in other materials.

The earliest use of the tumbling barrel on record was that carried out by violent lovers who put their hated rivals inside of barrels lined with sharp steel spikes and rolled them to the bottom of the hill, thus ending in a satisfactory and spectacular manner the future rivalry from the individual so treated.

It was found centuries later that the barrel form could be used satisfactorily for shaking



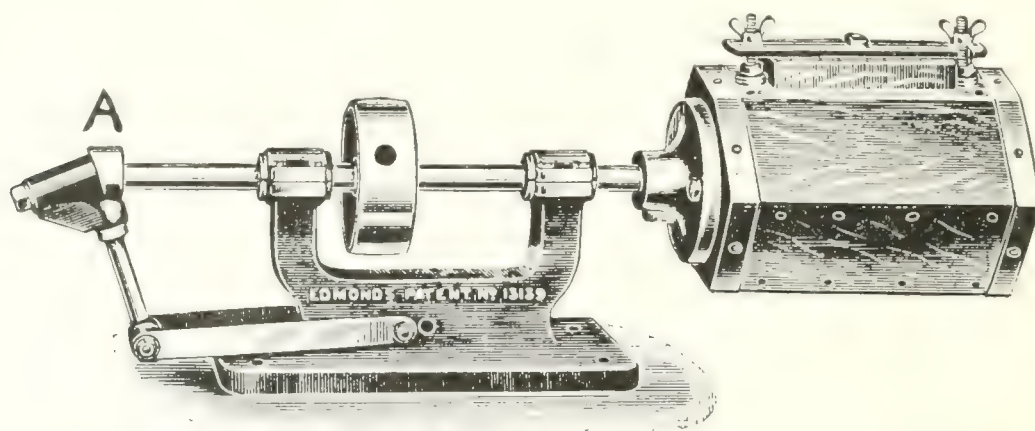
Early English Type of Barrel.

scribing the manufacture of needles, presented the following interesting paragraph: "After hardening and tempering the needles, the appearance, that they present, is a black blue. The blackness or scale has to be got rid of, and the needles made bright, smooth, and clear, and this is the result of the process of scouring (burnishing) which is accomplished by the friction of thousands of needles rolling against each other, aided by a mixture of oil, emery and soft soap."

The tumbling barrel became known as the "rattler" in the brick industry. By tumbling bricks against each other in a rotating barrel in connection with a charge of steel cubes, the hardness and toughness of the bricks were ascertained by estimating the loss by attrition. This practice is still carried out as a test on objects in brick form for paving purposes.

In the ceramic industries in preparing the materials for the glazes applied to pottery and for enameling purposes, the rotating tumbling barrel idea is used, now dignified with the name of a grinding mill, the content being ground to a fine powder by means of Icelandic or Danish pebbles of various sizes. In many

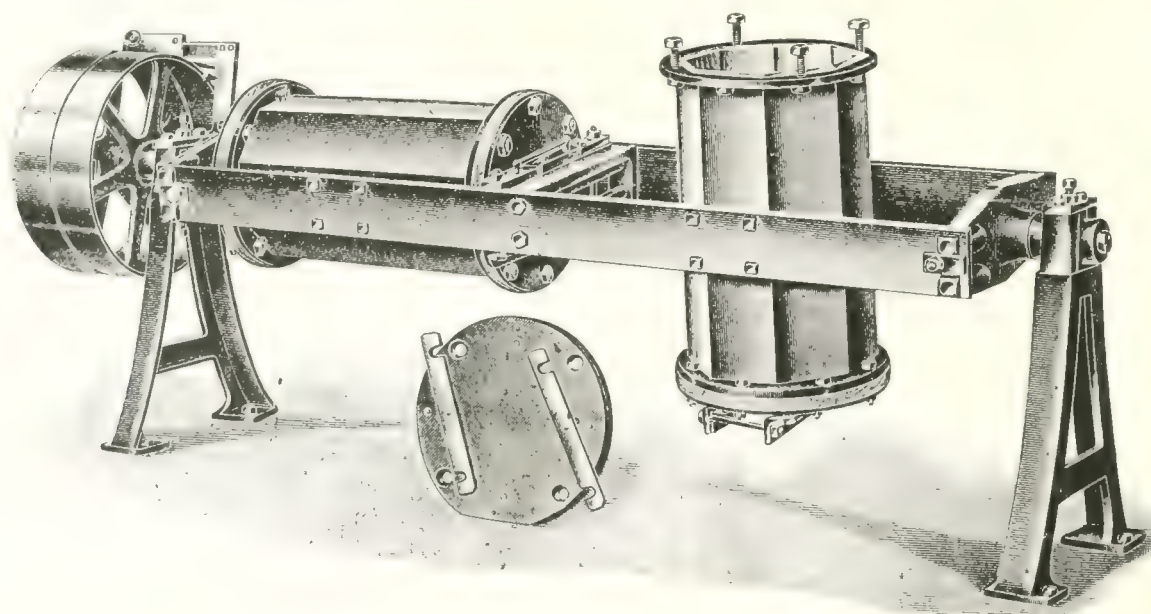
wares and jewelry. A very successful machine was known as the "Edmonds Patent Rapid Polishing & Burnishing Machine." Its principle of operation involved the employment of a reciprocating horizontal motion as well as the simple rotary motion previously employed in other types.



Reciprocating Tumbling Barrel for Use with Steel Balls.

other industries, the tumbling barrel under different names is used successfully and it was inevitable that in the course of time the electroplating industry should adopt some form of it for its purposes. It is not known who was the first man to conceive the particular application of the tumbling barrel for

In the illustration (Fig. 3) will be noted the method of imparting the horizontal motion as shown by the A at the end of the shaft. As the barrel revolves, the shaft is given a horizontal motion which shakes the articles so that they are thrown in every direction and do not separate in rows or grooves. These barrels



Early Type of Henderson Barrel.

polishing metal goods. It is quite certain that in England as far back as 1870, this application had been made.

The jewelers in England in 1886 were buying and using small barrels (Figs. 1 and 2) for the purpose of polishing their small metal

were extensively used in England at that time and several of them found their way into the United States.

It is interesting to note that in the operation of the Edmonds barrel, steel balls were used for the burnishing of the articles in every

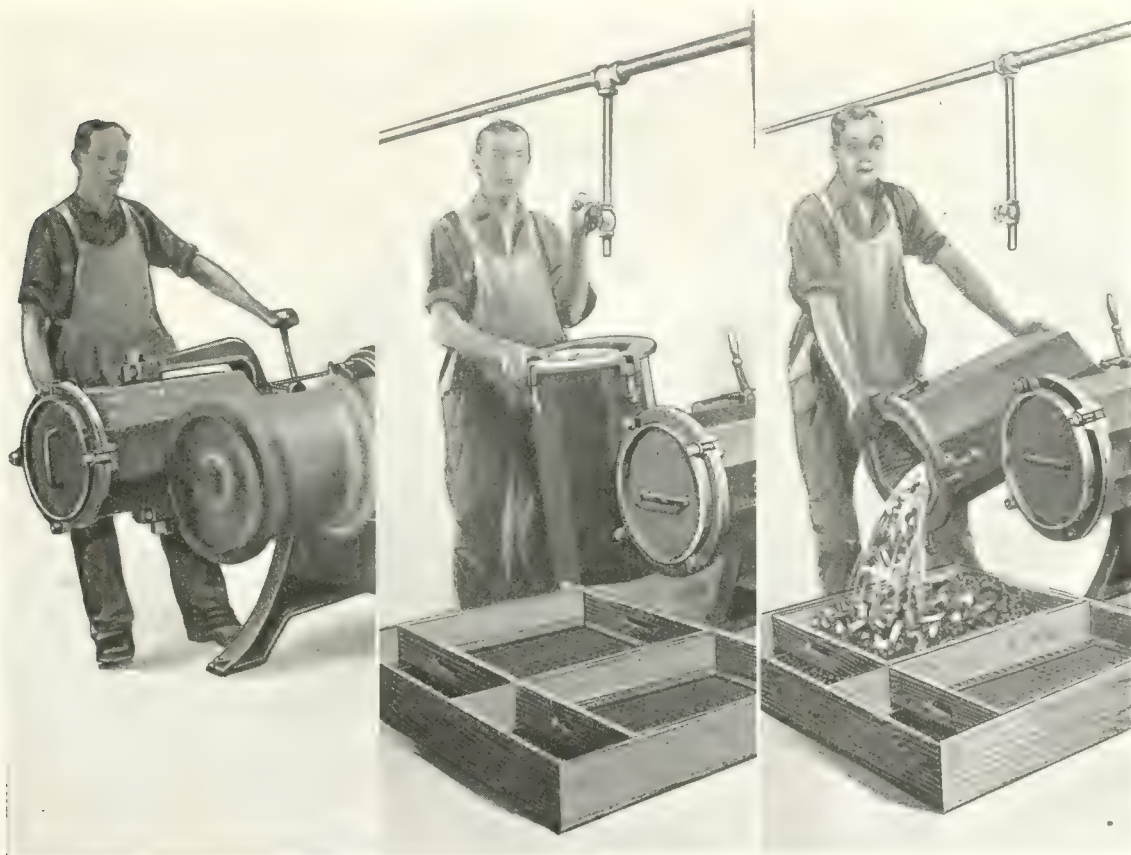
case, and the results obtained at that date, when the question of using different sizes of steel balls had not been taken up, were sufficiently surprising to bring about a ready adoption of this method of burnishing. The balls used were the ordinary bicycle balls which at that time were quite expensive.

An old circular of Sept. 3rd, 1903, furnished with the Edmonds barrel, reads:

"Two bags of 1-4 inch size steel Bicycle Balls of 25 gross each and one bag of 3-6 inch size are packed with each barrel. Having put into

for polishing metal goods was suggested and followed. As far as we can discover, this was about the year 1890.

The manufacturing jeweler was the first to benefit by the discovery. Their products were small and their sale depended on their highly polished appearance. Hand-burnishing then as now was an expensive operation and the steel balls even at the high prices they then commanded, were much cheaper in their operation and produced results equal to those obtained by the skilled hand-burnisher.



A. In Operation.

The Baird Burnishing Barrel.
B. Tipped Up to Fill.

C. Emptying.

barrels this quantity of balls now add water about 2-3 full, and sufficient soap of good quality to form a sufficient lather. Brass foundry articles, hat and coat hooks, stamped and embossed plates, etc., can be finished with great success."

Nor is it known who first discovered the utility of steel balls for this purpose. We of course, do know that their application could have only been subsequent to the introduction of the bicycle. As soon as the bicycle trade grew enough to warrant the manufacture of steel balls in large quantities, their application to other purposes was sought and their use

During the next decade, kindred trades adopted the ball-burnishing method and in England a public demonstration was given at the Bingley Hall Industrial Exhibition, Birmingham, in 1901, in which the burnishing and polishing of metal goods was shown in a barrel by means of steel balls and a lubricant.

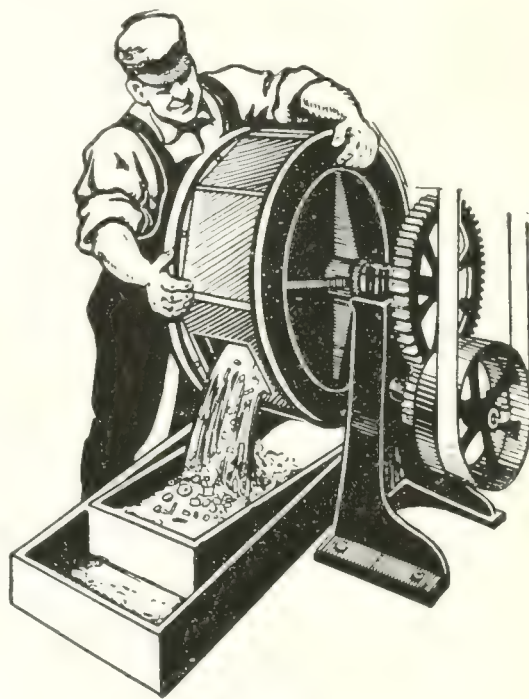
From the year 1900 to 1906 the ball-burnishing barrel grew in favor of the United States contemporaneously with the rapid growth of the hardware and similar industries. Providence, R. I., Waterbury, Conn., Bridgeport, Conn. and other important manufacturing centers in New England were constant users

and adopters of this new method of polishing. It has been estimated that there were over 100 ball-burnishing barrels operating in and around Providence, R. I., as early as 1902, most of them being small and used by jewelry manufacturers. The cost of steel balls for burnishing at that time was from 60 to 70 cents a pound. The metal-ware trades were slower to adopt the barrel method on account of the large size of barrel required and the great quantity of steel balls necessary.

The New England Watch Co., Waterbury, Conn. was one of the first to utilize the tumbling barrel for burnishing soft metal goods with hardened steel balls and soapy water. The company had been experimenting for a considerable time to discover a satisfactory method of polishing its main springs. Irregular shaped pieces of iron or steel had been used, but occasioned such loss by breaking the springs that steel balls were finally adopted for operating purposes. This was in 1904. It was found that as the balls were not in constant use, they became rusty and they were put into a tumbling barrel to be repolished. A few pieces of brass which happened to be in the barrel along with the balls came out with a very fine surface and polish and this led them to believe that this method of polishing would be adaptable to other parts of their products. They placed the order for machines of their own design with Henderson Bros., Waterbury, Conn., who were the first commercial builders, in this country, of barrels for this work. The New England Watch Co. secured two pairs of these barrels of octagonal form in July and one pair of cylindrical form in December 1904. The successful application of this method of polishing was immediately apparent and the company generously communicated the result of their experiments to other manufacturers in the state and a demand for similar barrels for this purpose grew steadily from that time.

The successful use of steel balls and barrels for the polishing process having been established, it was natural that careful consideration should be given to the construction of the barrels with a view of obtaining the highest efficiency. Several firms undertook considerable experimental work and types of the barrels which had been evolved as a result of these investigations are presented in this article.

It was also found that no matter what the shape of the barrel might be, it was always possible to discover a variation in the results obtained owing to the diversity of sizes and shapes of products to be polished. This led to the study of the proper sizes for the steel balls and by utilizing masses of balls of different diameters and different proportions according to the character of the goods to be polished, uniform results have been obtained. This has brought into play an engineering knowledge in the experimental departments of those manufacturing ball-burnishing barrels which enables the manufacturer to handle any product of any shape and size with an assurance of success. The illustration shows examples of the many types now handled satisfactorily by this method.

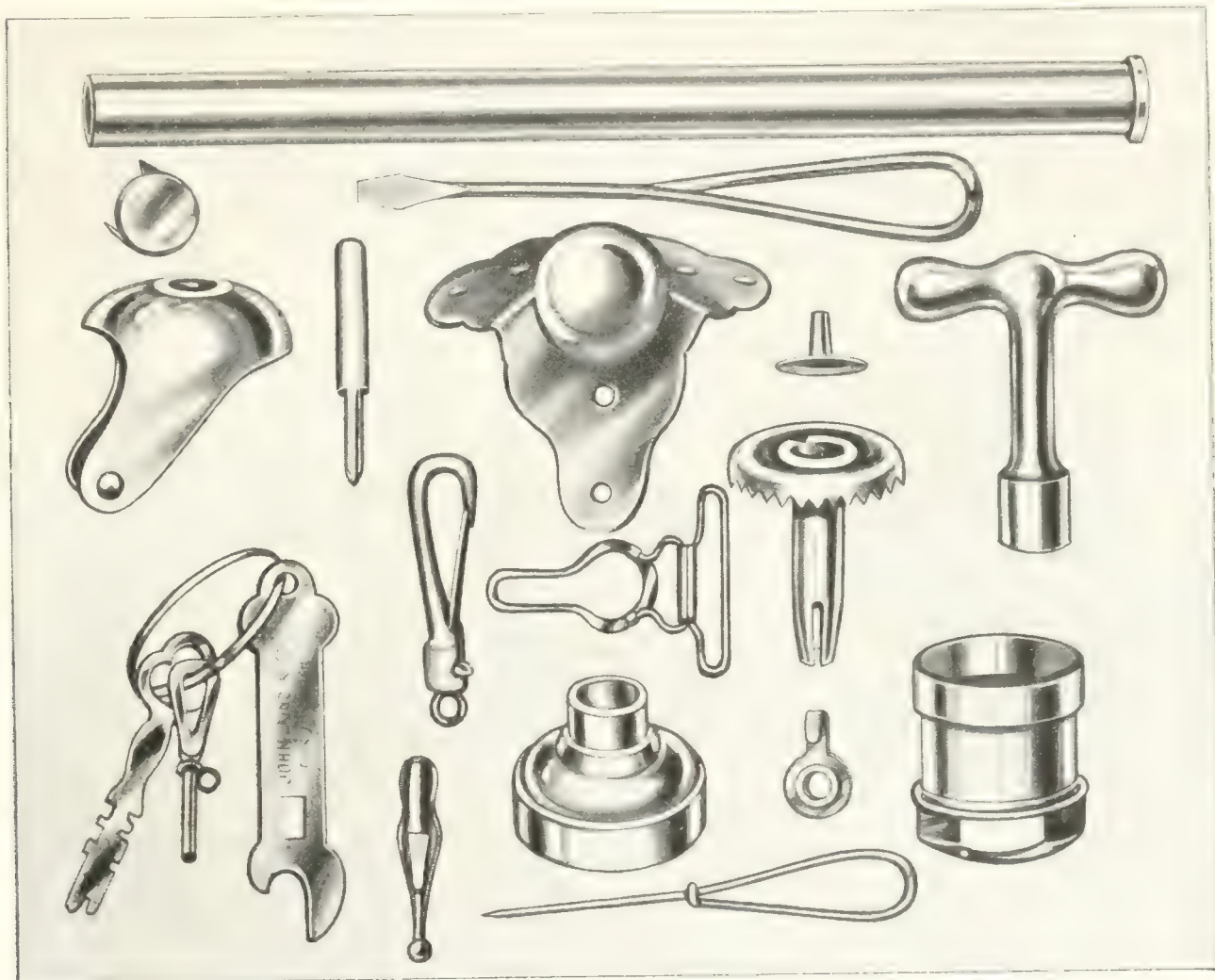


Abbott Burnishing Barrel.
Showing Method of Emptying.

The altering of the sizes of the steel balls was not, however, sufficient to solve all problems. It was speedily found that on certain classes of work where narrow grooves were present, that small pointed pieces of metal, punchings, disks, etc., used with steel balls, were necessary to bring about a uniform finish and now by study of conditions pieces so widely different as screws, flat circular moving-picture parts, buckles, etc., may be handled with assurance of success in the polishing or burnishing barrel.

It was in October, 1906, that the first practical and extended description of ball-burnishing methods was presented to the trade in the current issue of the "Brass World and Platers' Guide." Erwin S. Sperry, the journal's editor, was a tireless and conscientious experimenter,

Electro-Chemical Society and heads of all manufacturing enterprises interested in the plating of their products. A most instructive program is to be prepared and the plating will be done by C. H. Proctor, the lecture being given by Dr. Weber, both experts in their re-



Types of Varied Forms of Metal Goods Handled Successfully in Burnishing Barrels.

and contributed by his writings a definite aid to the ready acceptance of the process as reliable and effective.

METAL CYANIDE DEMONSTRATION.

An interesting demonstration of the efficiency of metal cyanides for plating purposes will be made at the Lewis Institute, Chicago, Ill., on Thursday evening, February 11th. Invitations to witness the work will be extended to the Chicago and Milwaukee branches of the American Electroplaters' Society, the American Chemical Society and the American

spective departments of work. It is expected that several prominent technical men will furnish papers on the subject. The Lewis Institute is one of the best institutions in the United States and under its roof many important experiments and tests have been performed which have contributed to the development of our national industries.

Glue for use in the plating room should be well boiled, and the wheels, after cleaning off the old glue and emery, must be sized with a thin mixture of glue and hot water and after drying, coated with the regular glue or rolled in emery.

"NICHROME."

New Standard for Acid Resistance

Recent trials and research disclose the fact that the alloy "Nichrome" possesses characteristics especially suiting it for use in the making of dipping baskets, containers, frames, wire cloth and other products of this nature, used in the plating industry.

The first practical tests indicate the ratio of endurance of this alloy, compared with iron, to be about 100 to 1. This is taking as a test sample, a dipping basket, used at a temperature of approximately 1600 deg. F., in a cyanide bath. The manufacturers state that frequent reports received from different branches of the chemical industry show that this material is finding much favor among platers.

The material may be obtained in the form of castings, all sizes of round and flattened wire, strip up to 4 inches in width, wire cloth and wire forms. Castings of Nichrome are said to be stronger than mild cast steel. The material has a fusing point of approximately 2750 deg. F., resists the action of acids, is non-corrosive and non-oxidizing. The tensile strength of castings made from the alloy is about 75,000 lb. per square inch, and in wire form 100,000 lb. per square inch. The alloy may be machined or turned without unusual difficulty.

It would seem that here we have a material, which takes the place of precious metals, at a comparatively low price.

Nichrome is manufactured by the Driver-Harris Wire Co., Harrison, N. J., from whom special information may be obtained.

WANTED—ELECTROPLATERS FROM NEW YORK AND NEW JERSEY.

A general call has been made for electroplaters from New York and New Jersey to put a superlative finish to the "high lights" on Broadway, February 20th, 1915.

The Banquet Committee of the New York and Newark branches of the American Electro Platers' Society has issued it and is laying plans for the greatest gathering ever held by electroplaters in the East. The great good accomplished by these annual pow-wows is a matter of record. No man with red blood in his veins and gray matter in his brain can attend a meeting of this kind without receiving a distinct charge of new life, energy and ambition.

The time is right—Saturday evening. The earlier we get there, the more we shall see and hear and learn. Manufacturers, superintendents, platers and all directly or indirectly interested in plating are invited. An exhibition of plated material in all finishes will be made. Get special details from Phillip Sievering, secretary, 54 Nairn Place, Newark, N. J. H. C. Bernard is the chairman of the Banquet Committee. The reason that this notice is inserted in the "Brass World and Platers' Guide" is not that it may fill up space but first, that you, if within geographical reach, may make up your mind to be with us. Second, if you are too far away to be with us, make it your special business to attend similar gatherings in your own territory. If there are no gatherings, start something. In other words if you have nought and place yourself as one before it, you have 10 to crow about.

BRIDGEPORT ELECTROPLATERS, GATHERING.

The December meeting of the Bridgeport branch was a most successful one. There was a large turnout of members and visitors from several Connecticut cities as well as a good showing for Bridgeport, about 55 being in attendance.

The attraction was a demonstration of the metal cyanides, which was given by representatives of the Roessler & Hasslacher Chemical Co., New York City. W. J. Schneider performed the practical work, while C. H. Proctor gave the demonstration talk. Preliminary to the demonstration, Mr. Proctor read a thoughtful and interesting paper, by Dr. Max Weber, on the advantages of these salts. The practical demonstration was successfully performed, various articles of various compositions, being plated easily and quickly with zinc, copper and brass.

Now that the branch has made a start with its practical work, it is hoped that similar experimental work will be done at subsequent meetings, the branches' laboratory being exceptionally well equipped for this purpose.

Following the demonstration, most of those present adjourned in a body to the Fairfield, a few minute's walk from the meeting room, and enjoyed a Dutch supper, which proved a most sociable and fitting ending of the year's activities.

INSIDE, OUTSIDE, OXIDE!

BY R. R. CLARKE.

Continued from Page 502, December 1914.

The elements most ordinarily used in non-ferrous alloys are tin, lead, zinc, antimony, aluminum, copper, manganese and nickel. The first four named may be regarded as low degree and the last four as high degree melting constituents. All combine with oxygen under favorable conditions, producing their oxides which are known to chemistry respectively as follows: stannic, or tin oxide; lead monoxide; zinc oxide; antimonyl, or oxide of antimony; aluminum oxide, or alumina; cupric, or copper oxide; manganese dioxide, and nickel oxide. The chemical expression for these oxides in their order is: SnO_2 — PbO — ZnO — SbO — Al_2O_3 — CuO — MnO_2 and NiO . To avoid misunderstanding it might be well to state that nickel oxide (NiO) is formed by heating nickelous hydroxide, $\text{Ni}(\text{OH})_2$, and aluminum oxide, or alumina, (Al_2O_3), can also be obtained by heating aluminum hydroxide, $\text{Al}(\text{OH})_3$. However, alumina is a consequence also of heating aluminum in the air and the fact that the oxide of a metal is developed from its hydroxide is no evidence that that metal in its molten state will enjoy exemption from oxidation.

Incorporated in metals or alloys these oxides approximate similarity of effect in one respect at least. All are of the earth, earthly and bereft of those virgin qualities and functions native to the metals from which they derive their origin and over which they exercise their weakening power or tendency. The nature of these oxides is lifeless and absolute absence of any quality kindred to the metals of their origin is noted.

In other respects they differ, each one possessing its own peculiarities; thus zinc oxide (ZnO) is soft and fleecy, in color, white, turning to yellow when heated; cupric oxide (CuO) a black solid; and artificial alumina (Al_2O_3), a white powder. In an alloy where a purely chemical union is realized it is scarcely illogical to conclude that oxidation produces an oxide in which each element is more or less represented.

The oxide evil in a non-ferrous alloy, though often given little attention, is no light or trivial affair. The very laws of Nature have

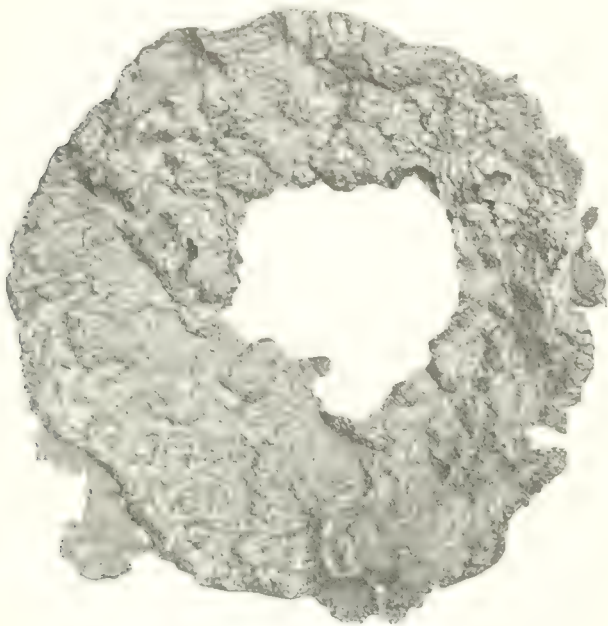
decreed their inevitable development and with her own hand she stamps their deadly effect on metal. Those effects are active, when existent, in every brass and bronze alloy for every purpose made. The consequences of their presence can be summed up in the one word "weakness". They are responsible for fracture under strain, breakage in heavy duty, leakage in the presence of fluid pressure, hard and "gritty" substances in bearing metals, and most pronounced imperfections in finishing and heating qualities. Destruction is the law of oxidation, all around debility follows in its wake and the casting is the repository of its consequence, the tell-tale of its evil. A section of scorched cloth in a garment is of no greater detriment than a section of oxidized metal in a casting.

The whole philosophy of oxidation and metal oxides can be concretely studied in many commodities of everyday life. An ordinary electric light bulb of the incandescent tungsten variety can be made to furnish an excellent demonstration of their cause and effect. The glass of the bulb encloses a vacuum in which a fine metallic wire is suspended. The passage of the electric current through this wire heats it to incandescence, yet, so long as the vacuum is maintained, no injury to the wire is manifest. If we remove an incandescent bulb from its socket after having burned for any length of time, carefully break the glass and examine the wire we will find the wire has retained all its metallic qualities. If now we place this glass-broken bulb back in its socket, pass the current through it again, the wire will flash and sparkle for an instant, then die to blackness through a yellow, reddish hue. It is the blackness of ruin, the death of functional form, the toll of oxidation. For the wire will now snap with a breath of air and crumble in the soft flesh of the hand. What happened? Oxidation only. Through all the heat of incandescence in a vacuum the wire remained a metallic substance. Exposed to the oxygen of the air—in a flash it became an oxide.

Now, what happened to the charged wire in the air, is exactly what will happen to mol-

ten metal in the air. It is not to be conceived that oxidation produced the heat of incandescence in the wire; resistance to the electric current did that, and in doing so merely created the conditions under which the impairing tendency of oxygen could operate to the destruction of the wire as a medium of incandescence. Likewise, it is not the heat required to reduce solid metal to liquid metal that destroys the

after being skimmed off, this scum will form anew before the eye can obtain even a glance at the true appearance of the molten mass beneath. The surface appearance of the metal under charcoal protection is not so. By pushing a small area of the charcoal quickly aside, a rapid glance at the metal reveals a clear, liquid surface over which a scum quickly forms. By comparing the metal of unprotected surface with a body of molten metal of similar consistency and containing phosphorus as a deoxidizer (copper 79, tin 10, lead 10, phosphorus 1), we can note the difference between a highly oxidized and a partially deoxidized molten metal. In the latter, the surface is clear and liquid.



Top of Gate Cooled in Air. (Copper, Tin, Lead.)

metal. Such heat is supplied heat, in the production of which oxidation operates to the destruction of the fuel. But, as in the case of the wire, this supplied heat is taken up by the metal, creating conditions therein favorable to the combining tendency of oxygen. The one great lesson for the foundryman to learn is that it is the contact between his melting or molten metal and the atmosphere and not the supplied heat that is directly responsible for oxidation and oxides. To be sure, the super-heating of metal is an evil; but it is an evil principally because it is a waste of fuel and both facilitates and intensifies the work of the oxygen.

An ocular demonstration of oxidation in molten metal can easily be realized by observing two molten bodies of ordinary bronze (copper 80, tin 10, lead 10) one with, and the other without a charcoal surface protection. The surface of the unprotected metal is sluggish, constantly developing a scum, in the same manner as a sheet of paper burned to ashes which retains a semblance of its sheet form. Surface oxidation is so rapid that,



Top of Gate Cooled Under Charcoal Protection. (Copper, Tin, Lead.)

All that we have thus far written were of little worth did we not consider some remedy for the evil. In consequence we shall accord this particular a few passing remarks.

Oxides are a natural and ever-recurring consequence and must be met and overcome by natural means. Air containing oxygen, and oxygen conceded to be the oxidizing principle, it is at once evident that to exclude the oxide we must *exclude* the air; that what we cannot exclude we must *eliminate* and what we can neither exclude nor eliminate, we must *isolate*. Briefly stated, then, the foundryman must combat oxide and oxidation by *Prevention, Elimination* and *Isolation*. We shall consider these separately in the order named:

Prevention.

The old adage of ounce and pound never had a better application. Bodily tissues are better off without disease, no matter how efficient the cure thereof may be. Likewise, metal never oxidized in the foundry, is stronger, cleaner, better, no matter how completely the oxides have been driven out or to what universal isolation in the casting we may confine them.

In prevention, the foundryman finds his field of most useful and efficient effort. Every detail of the situation can well be afforded the most careful consideration and there are many. Comment has already been made on metal storage bins and "shaking out" of castings in highly heated state. On some, the gravity of this latter feature may rest but lightly. Judging from practice, many brass men appear to entertain more or less doubt as to whether a heated solid can develop much of an injurious oxide. To those to whom this may apply we would suggest the surface appearance of a superheated or burnt copper soldering iron. We might suggest further for their consideration that if a chemist can get his cupric oxide by passing a current of air over

so, what about the returned product to be used over again? Is it not well-nigh time that non-ferrous interests were according a more serious consideration to the quality of the metal that constitutes a scrap product?

In a recent article on "high lead metal" we recommended the uncovering of castings in the molds as quickly as solidity would permit, and for this we may now be charged with inconsistency. In this, we wish to state that we did not recommend this practice in ignorance of the oxidizing result. By the nature of this particular case, we were confronted by two evils, of which we chose the lesser, and consequently recommended it.



Section of Casting Containing Oxidized Metal.



Section of Casting Free from Oxide.

a copper sheet heated to redness, why can a non-ferrous foundryman not develop a quantitatively copper-basic oxide by exposing superheated castings to the air?

Others might argue further that such oxidation is only a surface affair and can have no effect on the vitals of the casting metal. Even

However important the care of metal prior and subsequent to its molten state may be, it remains for the metal in that molten state to claim the brass man's special consideration. Thereto the exclusion of air is the paramount issue and no amount of time, labor and expense tending to this end will outvalue its reward. As an artist guards his work of new molded clay from the touch of a vandal hand, so should the brass man protect his molten metal against atmospheric exposure nor should this protection for an instant be unnecessarily withdrawn. Few evils are more rapidly executed than that with which oxygen combines with molten metal. Even in dropping from the "lip" of the pot to the sprue hole in the mold, its activity is evidenced, its evil done.

To be Continued.

RAW MATERIALS AND THE WAR.*

More than half our normal imports are either raw materials or manufactures for further use in manufacturing, and the war shortage of many of these should point the way to a more secure condition. In planning for this we must not be misled into considering one factor alone. For the present we must remember that the world's consumption of many commodities will be curtailed even more than the production and that the disturbance from reduced supply is not gravest with the largest items. Tungsten imports are about \$1,200,000, which is less than one-fourth the amount for raw chewing gum, but tungsten underlies two industries that directly save us over a million dollars a day. Similarly manganese bearing imports are much less in value than cigarette tobacco, but the vast steel industry is crippled by any shortage of manganese.

The selected illustrative items presented show the breadth of the field affected, in which our trades are more or less directly interested.

METALS

Aluminum, 4.3 million dollars Ger., Eng., Fr. America already largest producer. Opportunity for enlargement.

Antimony, 1.1, China via Eng. and direct, also Fr. Used in type, babbitt, and chemicals. No U. S. supply of consequence. An important material.

Bismuth, 0.3, Bolivia via Eng. Stereotyping and automatic sprinkler links. U. S. produces half its consumption.

Copper, ore, matte, and ingot, total import 15.5—from Europe 9.6. Total export 110, mostly to Europe. Imports are from Spain for electrolytic refining or else arbitrage sales. War has stopped imports and cut exports.

Iron and steel, pig iron, 6.4, Eng. Bar iron 1.3, Swed. Most serious feature in iron trade is stoppage of special ores and ferro compounds entering manufacture. Some of these are grouped here.

Manganese ore and oxide, 2.2, Rus., Ind., Brazil. Used in steel manufacture. Undeveloped deposits in So. Am. and Philippines. Situation serious.

Ferro silicon, imported as pig iron. Can produce in U. S.

Chromium ore, 0.6, So. Af., Aust., Rus. Used in special steels and in tanning and dyeing. Domestic production trifling. Particularly important to automobile and upper-leather manufacturers.

Nickel, 6.5, Canada. Not affected yet. No important domestic supply.

Tungsten ore, 0.1, Burma, Portugal. American production in Boulder County, Col., could probably be extended to care for requirements. Basis of incandescent lamp and alloy tool steel.

Vanadium. From Peru. Not affected.

Platinum, 5.2, Rus. (Ural Mts.). Some from Columbia. Highly important in chemical arts.

Tin, 53.1, Straits Set., Banka (Dutch) China (Hongkong), Bolivia (via Ger.), Eng. (Cornwall) formerly large producer, now small factor. No domestic supply known. Violent fluctuations of price since war. Foreign demand falling off about as much as supply. Movement to smelt Bolivian ore here.

Zinc, import 2.6, Ger., Belg. Export 1.6. Import and export equalizing markets. Domestic production sufficient for needs. All European zinc producers in fighting area.

CHEMICALS, DRUGS, AND DYES.

Total class, 98.8 million imports. Our only chemical exports of financial consequence besides phosphate rock are acetate of lime (2.2), calcium carbide (1.0), wood alcohol (0.8) and tanning extracts (0.5). Some of the imports are:

Acids, 1.8, Eng., Ger.

Ammonium salts, 4.2, Scot. Mostly fertilizer. By-product of Scotch shale oil and gas plants. We waste vastly greater quantities in coke manufacture.

Amyl alcohol, 1.2, Ger., Rus., Eng. Used in varnishes, lacquers, and making smokeless powder.

Camphor, 1.2, Japan. Essential to celluloid industry.

Potash salts of all kinds, 5.8, Ger. Of these 3.9 are for fertilizer. Also important in glass. At present a German monopoly.

Phosphate Rock, exports—high grade hard rock 4.9, pebble, 4.6. This business will probably suffer severely.

Oils,

Benzine, 1.3, Straits Set., Peru, Eng.

Cocanut, 4.2, East Indies, Eng., Nlds. Mostly for Soap.

Palm, 5.2, Eng., Ger. Soap, etc.

Shellac, 3.0, Ind. Some promising substitutes are being developed in America.

MISCELLANEOUS RAW AND MANUFACTURED MATERIALS

Ball bearings and balls, 2.4 Ger., Swed., It. Low European prices for high grades have held our production down.

Bristles, 3.5, Rus. Ger., Eng., China. Germany and England appear as exporters of sorted bristles. Original supply is from Russia. Good artificial bristles have been made here. Shortage is already serious.

Cork, 3.2, Port. Sp. These countries produce practically the world's supply.

Emery, 0.3, Turkey, Naxos (Greece). World's supply almost wholly from this source. Artificial abrasives would largely replace if price became excessive.

Plumbago or graphite, 2.0, Ceylon, Mex. World's supply of crucible graphite nearly all from Ceylon.

Leather, 9.1, Eng., Ger., Fr. Certain grades are largely imported.

Hides and skins, calf, 26.3, Rus., Ger., Fr., Ind. Cattle, 46.3, So. Am., Rus., Fr., Belg., Ger., Novgorod. Goat, 24.7, India, China, Rus., Mex., Eng. Horse and Colt, 3.1, Rus., Fr. Ger., Nlds. Russia is the great horse-hide producer for the world. Sheep, 12.4, Eng., Rus., New Z., Ind. Buffalo, 2.8 Ind.

Gutta-percha, 2.3 Straits Set. Balata 0.8 So. Am.

India rubber, 90.2 So. Am., Afr., Oceania, East Ind. via Eng., Belg. Guayule, 4.3, Mex. Inherent market condition did not justify the initial rise.

*An interesting and timely excerpt from "The Little Journal", published by Arthur D. Little Inc., Chemists and Engineers, Boston, Mass.

A SHORT OUTLINE OF THE PRINCIPLES OF CHEMISTRY FOR ELECTROPLATERS.—VI.

BY ALLAN J. FIELD.

This number begins a new series of articles on chemical analysis. The series will be divided into two parts, qualitative and quantitative analysis.

As the names indicate, qualitative analysis shows how to test solutions, salts and metals for what they contain. After knowing the composition of the substance, the exact quantities of each constituent in the compound can be found by means of quantitative analysis. As qualitative analysis precedes quantitative analysis, it will be taken up first. On account of its value in showing how to test solutions for impurities that often interfere with the proper working of the solution, it is therefore of great importance to the plater that he should understand how to test for the common metals and acids. The operation of testing solutions is nothing more than research on a small scale. The word research is considered out of place in a plating shop and, it is stated, should be strictly confined to laboratories of universities with their highly trained directors. Such a fallacy is gradually giving way to the broader view, that the plating shop where the problems are found is the place and the plater who finds them is the man to solve them.

Unfortunately the plater, in the majority of cases, has not the chemical knowledge, and the universities seldom hear of the problems or they are too commercial to be in their line; for this reason research is confined to a few investigators who delve in a small portion, and until the platers as a class undertake to get the necessary knowledge and solve their own problems, electroplating will always be a "money-getter" and not a science.

This series of articles, it is hoped, will be of some help in this direction and the author will feel amply repaid if it is the means of only one or two getting a start to hammer away at some of the unsolved problems. Directions have already been given in article III. for fitting up a laboratory. Additional chemicals and apparatus are given below, which will be all that are necessary for the qualitative course.

LIST OF CHEMICALS		PRICE
1 oz.	Silver nitrate c. p.	\$.50
1 oz.	Lead nitrate c. p.	.10
1 oz.	Mercurous nitrate c. p.	.25
1 oz.	Mercuric chloride c. p.	.20
1 oz.	Copper sulphate c. p.	.10
1 oz.	Stannous chloride c. p.	.10
1 oz.	Ferric chloride c. p.	.10
1 oz.	Ferrous sulphate c. p.	.10
1 oz.	Aluminum sulphate c. p.	.10
1 oz.	Zinc sulphate c. p.	.10
1 oz.	Nickel sulphate c. p.	.10
1 oz.	Manganese chloride c. p.	.10
1 oz.	Potassium ferrocyanide c. p.	.10
1 oz.	Sodium hydroxide in sticks	.10
1 lb.	Ammonium hydrate c. p. (.90)	.30
¼ lb.	Ammonium chloride c. p.	.10
6 lbs.	Hydrochloric acid 20° Com.	.59
1 lb.	Iron sulphide sticks	.20
1 book	100 strips red litmus paper	.10
1 book	100 strips blue litmus paper	.10

APPARATUS.

Bottle, wide mouth, round, 250 c.c.....	\$0.10
" " " " " 500 c.c.....	.15
Reagent bottle, narrow mouth, 250 c.c. HNO ₃ dil.....	.25
" " " " " H ₂ S.....	.25
" " " " " HCl dil.....	.25
" " " " " NaOH.....	.25
" " " " " (NH ₄) ₂ S.....	.25
Burner wingtop to fit Bunsen burner for bending tubes	.10
Clamp for test tube spring wire	.10
Funnels, glass, Bunsen's 6.5 cm. dia., (2 wanted).....	.24
Funnel tube, 30 cm. long.....	.08
Glass tubing, soft glass 7 m.m. external dia., 2 ft.....	.05
Paper, E. & A. white filter paper 10 cm. dia., 2 pkgs.	.26
Rubber stoppers No. 6, 2 holes.....	.07
" " " " " No. 8.....	.08
Rubber tubing, light wall black, 3-16 in inside dia., 1 ft.	.10

Hydrogen sulphide gas will have to be prepared quite often; the following illustration shows the apparatus for the preparation of it.

The large bottle is of 500 c.c. capacity fitted with a No. 8 rubber stopper and filled quarter full with iron sulphide. The funnel tube runs to the bottom of the bottle through which dil. HCl (1 part commercial acid and 1 part water) can be run in. A piece of glass tubing about 4 in. long is bent at right angles by means of the Bunsen burner.

Using a wingtop on the Bunsen burner will help to make a smoother curve. The glass tube is placed in the other hole in the stopper and connected to the small bottle with a piece of rubber tubing. The small bottle is fitted with two pieces of glass tubing; the one connected to the large bottle runs to the bottom of the bottle. The bottle is filled quarter full with water so as to absorb any HCl that may be carried over with the H_2S . The other tube

then carries off the H_2S and can be conducted into a solution by means of a piece of glass tubing.

To prepare the H_2S run into the large bottle about 100 c.c. dil. HCl (50 c.c. commercial HCl and 50 c.c. water). If action does not start right away, hot, stronger acid must be used, as after the iron sulphide has been used and allowed to stand for some time it becomes coated with iron oxide which has to be dissolved off first before H_2S can be generated.

The reaction between iron sulphide and hydrochloric acid as follows:



Hydrogen Sulphide Generator.

For making a simple test a solution of the gas in water will answer in place of the gas. The reagent bottle for H_2S is filled with water, which should be cold, as a cold liquid will absorb more gas than a hot one. Conduct the gas through the water for about twenty minutes. If the gas stops bubbling at any time either add more HCl or disconnect the tube from the apparatus, as otherwise the water will be drawn over into the apparatus. It is better to use the gas instead of the H_2S water when the metals are to be separated one from the other, so as to insure complete precipitation.

The plan of the work will be divided into two parts. The first part will show simple tests

for the different metals. The second part consists of methods for the separation of the metals when they occur in mixtures. The number of tests for each metal has been limited to as few as possible, as trying to become familiar with too many is apt to be confusing. It is better to have a few things well grounded, than a smattering of a large number. For further tests about the metals, or metals not given, a standard text book on qualitative analysis should be consulted.

The following terms should be remembered as they will be used to describe certain simple operations or manipulations:

Filtration—Is the method of separating a solid substance from a liquid by using porous paper known as filter paper. The filtrate is the liquid that passes through the filter paper. To prevent the liquid from running down the sides of the vessel when pouring out of it into the funnel a glass rod is held against the edge of the vessel.

Evaporation—The changing from the liquid state to the gaseous state. Heat is generally used to hasten it.

Reagent—Substances that bring about reactions are termed reagents.

Precipitation—When reagents throw out substances from solution the process is precipitation. The substances thrown down is termed a precipitate.

Neutralization—When the correct proportions of an alkali and an acid are taken and mixed so that there is no excess of either acid or alkali the solution is said to be neutral. The point of neutrality is shown by means of litmus paper; acids will turn it red and alkalies blue.

The following abbreviations have been generally adopted so as to shorten writing the directions: sol. for soluble; insol. for insoluble; dil. for dilute; conc. for concentrated; c.c. for cubic centimeter; c. p. for chemically pure; ppt. for precipitate. The symbols for the common reagents are as follows: H_2SO_4 = sulphuric acid; HCl = hydrochloric acid; HNO_3 = nitric acid; NH_4OH = ammonium hydrate; NaOH = sodium hydrate; H_2S = hydrogen sulphide; $(NH_4)_2S$ = ammonium sulphide.

When adding reagents they should be added in small portions, generally by drops, as some precipitates are soluble in excess of the reagents.

The following ten metals have been selected for the tests as they are those commonly found in the plating room: silver, lead, mercury, copper, tin, iron, aluminum, nickel, zinc, and manganese. The following acids are also included; sulphuric, nitric and hydrochloric. As ammonia might have to be looked for sometimes it is also included.

Silver.

A dilute solution of silver nitrate is made, that is, about one gram of the salt is dissolved in 100 c.c. of water. For the following tests about 5 c.c. portions are taken out into test tubes.

(1) To a portion add HCl in slight excess, that is, until no more of a ppt. forms. As the ppt. does not settle out readily in a cold solution the test tube should be heated, care being taken to keep the test tube in motion over the flame, as it will prevent the solution from being thrown out of the tube. The reaction between the HCl and silver nitrate (AgNO_3) is:—



The white ppt. is silver chloride which is insoluble in acids. After the ppt. settles to the bottom of the tube the solution above it can be poured off, then to the residue of silver chloride is added a little NH_4OH which dissolves it. Add carefully to the solution dil. HNO_3 (1 part HNO_3 and 1 part H_2O) until slightly acid; the silver chloride will be re-precipitated.

(2) To another portion add H_2S water. A black ppt. of silver sulphide (Ag_2S) will form as follows:—

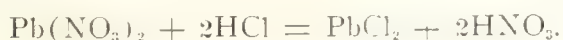


The Ag_2S is soluble in HNO_3 ; although HNO_3 is formed in the reaction as shown by the equation, it does not dissolve the silver sulphide because it is very dilute. Silver sulphide is also soluble in potassium cyanide (KCN).

Lead.

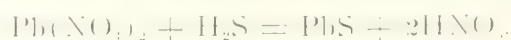
Prepare a dilute solution (about 1 gram in 100 c.c.) of lead nitrate [$\text{Pb}(\text{NO}_3)_2$].

(1) To 5 c.c. in a test tube add dilute HCl; a heavy white ppt. of lead chloride (PbCl_2) will form.



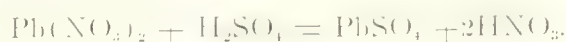
The solution is heated and the lead chloride will be dissolved. In cooling it will crystallize out again. This test is a quick method to distinguish between lead and silver as silver chloride is not soluble in hot water to any great extent.

(2) Add H_2S water to another portion. A black ppt. of lead sulphide (PbS) will form.



Lead sulphide is soluble in dil. HNO_3 .

(3) To another portion add dilute H_2SO_4 which causes a dense white ppt. of lead sulphate (PbSO_4).



The lead sulphate is soluble in sodium hydroxide (NaOH) forming sodium plumbite (Na_2PbO_2).

Mercury.

Mercury forms two series of salts, the mercurous and the mercuric, the mercurous compounds containing more mercury than the mercuric. The two series give different reactions with reagents. The mercurous compounds will be taken up first.

A dilute solution of mercurous nitrate is prepared; if it does not dissolve entirely a few drops of nitric acid will help it to do so.

(1) To about 5 c.c. add HCl, which will ppt. the mercury as mercurous chloride (Hg_2Cl_2).



Mercurous chloride is insoluble in boiling water (which distinguishes it from lead chloride which is soluble. If NH_4OH is added to Hg_2Cl_2 it will turn it black and decompose it.

(2) To another portion add H_2SO_4 which precipitates mercurous sulphate (Hg_2SO_4) as a white ppt. It is blackened by NaOH and is insoluble in excess (which distinguishes it from lead sulphate).

Hydrochloric and sulphuric acids do not give precipitates with mercuric salts as both the chloride and sulphate are soluble in water.

The three metals, silver, lead and mercury (mercurous) are known as the first group metals in qualitative analysis and the group reagent is HCl, that is, HCl will precipitate only these three metals and no others. The mercuric compounds belong to the second group and will be taken up in the next article.

THE CLASSIFICATION OF SCRAP METALS.

The Report of the Classification Committee of the National Association of Waste Material Dealers.

The preliminary report of this committee, which has been working for six months on a standard of classification for scrap metals, has lately been published. Morton B. Smith, New York, is chairman, and the other members of the committee are as follows: I. Grodin, Ivan Reitler, Charles E. Haskins, Harry Birkenstein, Henry Sissberger and R. M. Milligan. As a preliminary report, the following standards are suggested:

Heavy Copper

This shall consist of copper not less than 1-16 inch thick, and may include Trolley Wire, Heavy Field Wire, Heavy Armature Wire, that is not tangled, and also new Copper Clippings and Punchings, untinned and clean, and copper segments that are clean.

No. 1 Copper Wire

To consist of clean copper wire not smaller than No. 16 wire gauge, to be free of tin and all other foreign substances, to be free from burnt copper wire.

No. 2 Copper Wire

To consist of miscellaneous clean copper wire such as of necessity, would be taken out of the heavy copper and the No. 1 copper wire, but be free of hair wire, also burnt wire.

Light Copper

Shall consist of the bottoms of kettles and boilers, bath tub linings, hair wire and clean roofing copper and similar copper, to be clean, free from visible iron, paint, tar, scale and brass and lead connections, and free of excessive solder, also old electrotype shells.

Composition or Red Brass

Shall consist of red scrap brass, valves, machinery bearings and other parts of machinery, including miscellaneous castings made of copper, tin, zinc or lead, no piece to measure more than 12 inches over any one part, to be free of aluminum and manganese, also free of railroad boxes, cocks and faucets, gates, pot pieces, ingots and burned brass.

Railroad Bearings

Shall consist of railroad boxes of car journal bearings; must be old standard used scrap, free of yellow boxes, plastic and similar bear-

ings, also iron-backed boxes, and must be free of babbitt; also free of excessive grease and dirt.

Cocks and Faucets

To be mixed red and yellow, free of gas cocks and beer faucets; shall be at least half red.

Heavy Yellow Brass

Shall consist of heavy brass castings, also rolled brass, rod brass ends and brass screws, tinned or nickel-plated brass tubing; to be free of iron and dirt, and must be in pieces not too large for crucibles. Must also be free of aluminum and manganese mixtures. Condenser tubes shall not be considered as heavy brass.

Light Brass

Shall consist of light sheet brass, forks and spoons, miscellaneous brass that is too light for heavy, but to be free of any visible iron. Also to be free of gun shells containing paper or iron, of loaded lamp bases, and of clock works.

New Brass Clippings

Shall consist of the cuttings of new sheet brass and to be absolutely clean and free from any foreign substances.

Brass Tubing

Shall consist of brass tubing, free of nickel-plating, tinned soldered, or tubes with cast brass connections. To be sound, clean tubes, free of sediment, also free of condenser tubes.

No. 1 Composition Turnings.

To be free of aluminum, manganese, plastic and yellow brass turnings, not to contain over 2 per cent iron; to be free of grindings or foreign material, especially babbitt, and free from adulterations made to resemble metal. Turnings not according to this specification subject to sample.

No. 1 Yellow Brass Turnings

Shall consist of strictly rod turnings, free of aluminum, manganese, composition and tin turnings. Not to contain over 3 per cent of iron, oil or other moisture, to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample.

No. 1 Pewter

Shall consist of tableware and soda fountain boxes, but in any case must test 84 per cent tin. Syphon tops to be treated for separately.

Auto Radiators

To be classed separately; must be free of iron.

Zinc

Must consist of clean sheet and cast zinc, also cast batteries to be free of loose oxide and dross, salammoniac cans and other foreign materials.

Tin Foil

Must consist of pure foil free of lead compositions and other foreign ingredients and matters.

Electrotype Shells

Must be hand picked and free of dross.

Packages

Shall be good strong packages, suitable for shipment, and each package to be plainly marked with the gross and tare weights, so that when packages reach their destination, their weights can be easily checked.

◆ ◆ ◆
PERSONAL.

James H. Stitt, formerly of the Roessler & Hasslacher Chemical Co., has been appointed general eastern representative of the Ele-Kem Co., Chicago, with headquarters at 185 Madison Ave., New York City. Mr. Stitt has many friends among the platers of the country and his friends wish him every success in his new enterprise.

◆ ◆ ◆
OBITUARY.

Charles McNellis, president of the Imperial Brass Mfg. Co., Chicago, Ill., and one of the pioneer brass manufacturers, died recently at his residence in Chicago.

Charles Martin Hall, President of the Aluminum Co., of America, died December 27th, at Daytona, Fla. One of the greatest of American chemists, Mr. Hall was best known in connection with his work in cheapening aluminum. He was born in Thompson, O., and was a graduate of Oberlin College. In 1886 he revolutionised the aluminum industry by discovering a process for electrolytically obtaining the metal from alumina. His first factory at Kensington, Pa., was soon followed by larger works at Niagara Falls, while the present output of the various establishments of the company is several million pounds of metal. Most of the leading scientific societies of American as well as several of those in Europe will mourn his loss.

A NEW SPEED LATHE.

Particular attention is called to the new book just issued by Leiman Bros., 62 John St., New York, illustrating and describing their bench speed lathe.

This machine should be found in every tool room, jewelry and novelty shop or any sort of an experimental or machine shop, laboratory, training school, or home workshop. The machine is very accurately made, having dust proof bearings and hollow spindle.

Special attention is also called to the low price at which the machine is sold, making it possible for those who have use for a fine lathe to secure one without paying the exorbitant price ordinarily demanded for a tool of this kind.

The machine is especially adapted for turning rods and tubing, for reaming, burnishing, and spinning as well as for drilling, trimming, grinding, frazing and buffing work. The machine is supplied in many different combinations—that is to say, it is supplied mounted on a bench connected with an electric motor, and having the various fittings used in the above mentioned operations. This machine is very substantially built, heavier in fact than would appear necessary, all of which adds to the value of the machine, and makes it one that will last practically a life-time. The machine is made in two sizes, one having a two ft. bed and the other a three ft. bed. The swing however on each machine is the same—8 in., but the distance between the centers is 8 and 20 inches respectively.

The tail stock is fitted with a self-discharging center and the head stock with a three step cone pulley. The lathe, however, may be fitted with loose and tight pulleys for operating from a main shaft or a single pulley for operating with a motor.

The catalog referred to, is especially interesting to those having use for a machine of this kind, and as the price of the machine is much below that ordinarily demanded for a very accurate lathe it would be to the interest of those interested to secure a copy of the same.

Small steel articles such as buttons and buckles are generally given a black finish by tumbling in a sheet iron barrel heated to the proper temperature by means of a gas furnace.

ELECTRODEPOSITION OF LEAD.

At the October meeting of the American Electrochemical Society, held at Niagara Falls, interesting papers on the electrodeposition of lead from lead acetate, lead lactate and lead formate solutions were presented by Dr. Frank C. Mathers of Indiana University, in collaboration with Barrett W. Cockrum in one of these two papers. A summary of the results of their investigation is given below.

Lead fluosilicate and lead perchlorate baths are the only ones that have been used successfully in lead plating. The great disadvantage or objection to them is that they must be made by special apparatus and by troublesome methods. The actual electroplating with either of them is very easy.

The deposits of lead which were obtained by the electrolysis of lead acetate baths containing ammonium perchlorate and peptone were much better than had been obtained previously from any lead salt of a weak acid. The cathodes were smooth during the first part of the deposition, but as the thickness of the deposit increased the cathodes became more and more rough. All of these deposits were brittle. The deposit was not satisfactory, and something was lacking. Various addition agents have been experimented with, the result being the production of the best lead deposits ever obtained from the lead salt of a weak acid, much superior to those obtained with peptone as an addition agent.

For each liter (1.056 quarts) of bath there should be used 100 gm. lead acetate, 40 gm. ammonium perchlorate, 25 to 50 cc. of glacial acetic acid and addition substance prepared by one of five different methods. The best results were obtained from the following:

Treat 12.5 gm. of aloes with 500 cc. of warm water and shake until the soluble material has dissolved. Let stand until the insoluble tar or gum settles and adheres to the sides of the vessel. Dissolve this gum in the glacial acetic acid. Add this solution to the bath and electrolyze without filtering.

More extended experiments are to be made on the use of this aloes residue as addition agent.

Ammonium perchlorate was found to be necessary for the formation of a smooth deposit. An increase of this salt to 8 per cent. gave better deposits, but greatly increases the cost of the bath.

A current density of 0.4 amp. per sq. dm. (3.6 amp. per sq. ft.) must be used for thick deposits. For thin deposits in plating 0.8 amp. per sq. dm. may be used. With the higher current density, ammonium acetate cannot be used in place of the ammonium perchlorate.

The current efficiencies at the anode and at the cathode are near 100 per cent. The excellent corrosion of the anodes is proved by the fact that the copper wires attached to the anodes in the solution were not dissolved. The specific gravity of the deposited lead was 11.27.

More of the addition substance and more acetic acid must be added to the bath during the course of the electrolysis.

A similar method of experimenting was employed with lead lactate and lead formate solutions.

The baths that gave the best deposits contained 4 per cent of lead as lactate or 2 per cent of lead formate, 1 to 5 per cent of lactic or formic acid, 4 per cent of ammonium perchlorate and 0.25 per cent of Barbadoes aloes. This mixture was warmed and then filtered in order to remove the insoluble gum which was in the aloes.

A current density of 0.4 amp. per sq. dm. (3.6 amp. per sq. ft.) was found to be best; with higher current densities the deposit became rougher.

Thick deposits were obtained without difficulty. The specific gravity of this electrodeposited lead was 11.25 and 11.28 for the lactate and formate baths respectively.

Other addition agents were tried in the place of the Barbadoes aloes, but of these peptone was the only one of any marked value.

The only disadvantages in the use of baths containing lead salts of weak acids are:

- (a) A low current density must be used.
- (b) The deposits are brittle as a result of the large amount of addition substances that must be used.

Two kinds of corrosion are said to occur in aluminum. One of these consists of a uniform attack over the whole surface and the other, which is generally found on drawn or rolled metal, is localized in scales and spots. Corrosion is due to the combined effect of air and moisture. Worked aluminum scales off in the direction in which the mechanical action has been carried on.

THE PLATING OF BRASS BAND INSTRUMENTS.

As Conducted by One of the Largest Manufacturers
of High-Grade Band Instruments in the World.

BY W. W. FITZSIMONS.

The plating of band instruments is a special branch of the plating trade, and should be treated with the utmost care in consideration of the value of the instrument and the difficulty in its finishing; also because of the great danger of spoiling the tone of the instrument or injuring its mechanical working.

There are four methods used in this factory in plating instruments, which are—the silver plating of brass instruments, silver plating of second-hand instruments which have been plated before, nickel plating of brass instruments and nickel plating of instruments which have been plated before.

In the silver plating of a brass instrument the top caps and bottom caps are removed. The pumps and springs are then removed and tops and bottoms of the valves are very tightly corked with different sized corks which will fit these ends. The caps are then replaced over the cork. The reason for putting these caps back on the instrument is so that the threads will not be plated. The small water key-holes from which the water-key has been removed are then tightly corked with small corks or pieces of corks so that, when the instrument is filled with water, these water-key holes will not leak.

The instrument is then hung in the hot potash for about ten minutes. Do not cork the bell or mouthpiece before hanging it in the potash, but let potash run on the inside of the instrument, as this will have a tendency to remove all grease and dirt from the inside of the instrument. Remove the instrument from the potash, rinse well in clear water, running water through the instrument to remove all potash from the inside. Then fill the instrument with water, corking the mouthpiece and bell so that the water will not leak out of the instrument. The instrument is filled with water simply so that it will sink in the acid and silver solution. Then dip the instrument in acid, which must be done very quickly, and then well dinse in clear water. The acid dip used is—nitric acid, 10 gal., water, 5 gal., salt, $\frac{1}{2}$ pound.

Now, run instrument through cyanide dip and brush over with FF pumice stone and a soft brush, after which dip the instrument in a mercury dip composed of one-half pound corrosive sublimate, five pounds cyanide, five gallons of water. The instrument is now struck up in the regular silver strike until it has a yellowish deposit of silver.



Fig. 1. Turned Wooden Polishing Mandrels.

Now, rinse the instrument well, remove corks from bell and mouthpiece, running clear water through the instrument. Scratch brush with a small brass scratch brush (Fig. 3), place on a wooden polishing mandrel (Fig. 1) and sand with a piece of muslin and wet sand (Fig. 2) Now, sanding the instrument is done by drawing this piece of muslin covered with wet sand over all the tubing of the instrument, which will remove all the white deposit that you could not strike with the scratch brush. The instrument is then rinsed, filled with water and corked. *Always use a wet piece of cloth to handle instrument—never use the bare hands after the instrument has come from the acid,*

as the oil from the hands will cause the instrument to spot, which spots will be rough and be very liable to blister.

The reason for scratch-brushing and sanding the instrument after first striking it is so that all exposed soft solder will now be bright and clean, and will take silver very readily. The instrument is now brushed over with a soft brush and FF pumice stone, after which it is dipped for a few seconds in the silver

After sanding, it is a good policy to run over the instrument again with the scratch brush so that the sand marks will not show. All sand used in sanding these instruments should be run through a very fine sieve so that there will not be any little pieces of stone in the sand to scratch the instrument. Always sand the same way—what I mean is not to sand one way and then run the sand back across the opposite way, which would have a tendency to scratch



Fig. 2. Sanding Instrument.



Fig. 3. Scratch-Brushing.

strike to color the solder. Now, place the instrument in the regular silver plating solution and plate for desired length of time, which should be from two to four hours for a good heavy plate. After removing the instrument from the silver solution, pull corks from bell and mouthpipe, letting out the water, then pull all slides, remove tops and bottoms of valves and pull corks from same. Rinse well and scratch [brush] and sand as before.

the instrument. The brass part of the slides should now be brushed with pumice stone, struck up in the silver strike, and then scratch-brushed. The instrument is now ready for the burnishers.

The Silver-Plating of Second-Hand Instruments which Have Been Plated Before.

It is not good policy to try to strip off the old plating unless the plating has blistered or started to peel, as the metal from which band

instruments are made is very thin and their construction very delicate. If the plating which has started to peel is nickel it would be necessary to strip this instrument. Inexperienced platers of band instruments should not try to strip nickel from an instrument with the regular acid strip, but should use a strip which several of the plating supply houses are putting out, which will remove the nickel or silver without injury to the finished surface of the metal.

With the silver-plated horn on which the plating has blistered or started to peel, it is necessary only to place instrument on polishing mandrel and rag down to a smooth surface with a strip of muslin cloth covered with pumice stone and oil, the pumice stone and oil to be mixed to a thin paste and then rubbed on the cloth before using.

If the second-hand instrument to be silver-plated has been silver-plated before and the plating not blistered or started to peel, but



Fig. 4. Burnishing Engraving on Instrument.

worn through in spots, all that is necessary is to buff all the worn or rough spots down smooth. Before buffing, prepare the instrument the same as you would a brass instrument for silver-plating—corking, etc. After buffing, potash as before, rinse well inside and out, fill with water and cork mouthpipe and bell, dip in cyanide, remove corks from bell and mouthpipe and again rinse thoroughly. Place instrument on polishing mandrel and draw a piece of muslin, covered with wet FF pumice stone over all parts of the instrument. instrument, only use pumice stone instead of This is done the same as the sanding of the the sand.

Do not let the pumice stone dry on the instrument, but rinse frequently as it will be found difficult to get the pumice stone off any place where you could not reach it with a brush after it is dry. After cleaning the instrument with a cloth and pumice stone, brush over same with a soft brush and pumice stone, always handling instrument with a *wet cloth—never the bare hands*. Now fill the instrument with water, cork the mouthpipe and bell and dip in the mercury dip for a quarter of a minute or so. Then rinse well and color in the regular silver strike. Keep instrument moving in strike so that the ends will not be burnt. After striking, hang the instrument in the regular silver-plating solution and plate the desired length of time. After removing from the solution, finish the same as a new or brass instrument.

If the second-hand instrument to be silver-plated has been nickel-plated before, it will be necessary to strip and polish down to a smooth surface by placing the instrument on a polishing mandrel and rag with a strip of muslin and pumice stone and oil, after which cork, potash and plate as before.

To Nickel-Plate a New Brass Instrument or a Second-Hand Instrument which has been Plated Before.

In plating the new brass instrument which has never been plated before, all that is necessary is to remove the top and bottom caps and cork as before. Now, put instrument on polishing mandrel and polish with a good brass polish, so that the whole instrument is very bright. Then potash instrument, but do not leave it in the potash until it is oxidized. After potashing, fill with water, cork bell and mouthpipe, dip in cyanide dip to remove all tarnish and brush over all the instrument with Vienna lime, always handling the instrument with a wet cloth. After brushing, dip in cyanide dip and hang in regular nickel-plating solution and plate desired length of time, which should be from twenty minutes to one hour for a good plate.

If the instrument to be nickel-plated has been nickel-plated before, and the old nickel-plating has neither blistered nor peeled, but worn through in spots, buff the spots down smooth and polish until good and bright, and plate the same as you would a brass instrument. They are hung in the potash for a few moments, then cyanide, and brushed with wet powdered Vienna lime. After rinsing well, dipping in

cyanide dip and again rinsing, they are hung in the regular nickel plating solution. We do not consider it necessary to strike in copper, and never have any trouble in nickel plating in this manner.

If the nickel has blistered or peeled it will be necessary to strip the old nickel off and polish down smooth before plating.

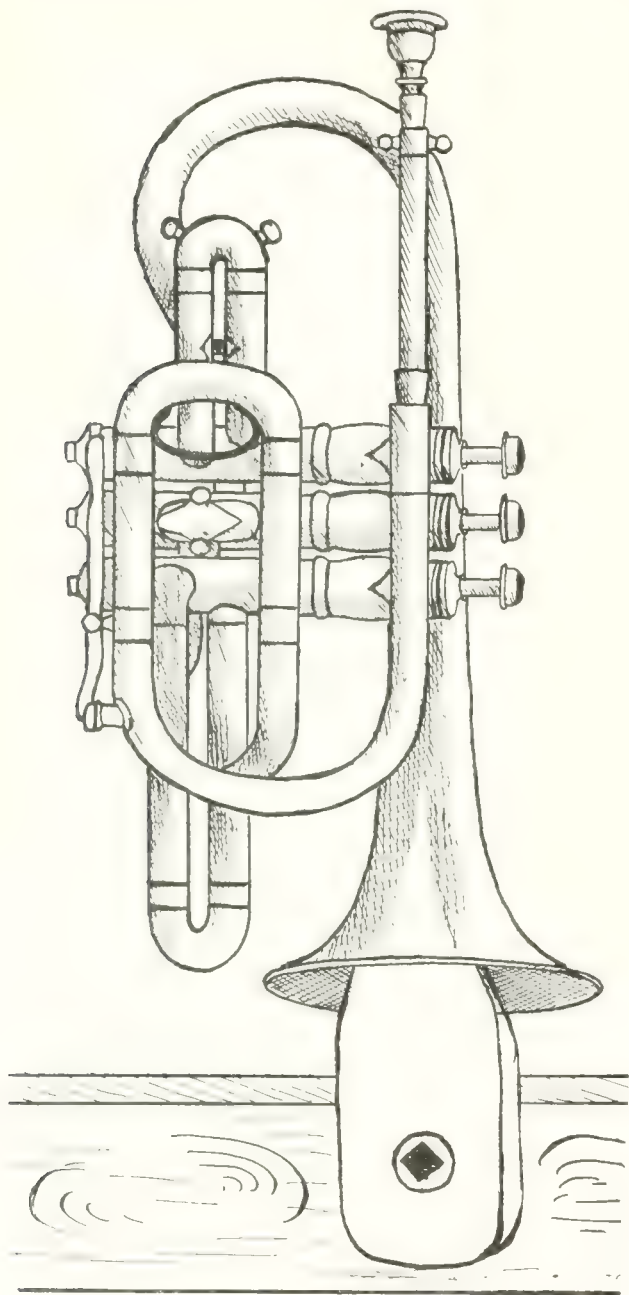


Fig. 5. Showing how Mandrel is Attached to Post for Holding Instruments.

If the instrument to be nickel-plated has been silver-plated before and the silver-plating blistered or started to peel, it will be necessary to strip or rag down smooth before nickel-plating. After polishing bright the instrument is plated the same as a brass-finished instrument. Instruments after nickel-plating are polished up with a nickel polish by placing the instrument on a polishing mandrel and running

over them with a strip of muslin or cheese cloth with the nickel polish on the cloth, and then run over again with a piece of cheese cloth covered with Vienna lime, which will remove all grease and give the nickel a high luster. Color inside and outside of bell with a small soft buff.

In plating new or second-hand instruments, never get any plating on the pumps or the inside of the valves as it would interfere with their working. All exposed threads on parts to be plated should be covered with a small piece of rubber gas hose cut to the right length to cover the thread. Never dip an instrument that has silver on it into the acid as the acid will have a tendency to pit and make the instrument rough over the entire silver surface.

AN ORIGINAL GREETING.

Those who know A. L. Haasis will see him in every line of this New Year letter recently



WHAT A JOYOUS YEAR IS AHEAD
FOR BOTH OF US.

1ST I AM TO SEE YOU -

WALLOW IN THE SUNSHINE OF
YOUR PRESENCE - SO TO SPEAK -
NO ONE CAN TAKE THAT FROM ME.

TO YOU, HOWEVER, IS GIVEN JOY,
EVEN GREATER. YOU, YOU, WILL
USE DIXON CRUCIBLES, AND WHAT
GREATER BLESSING CAN GOD GIVE
TO MAN?

SINCERELY YOURS

JERSEY CITY, JANUARY, 1915 *A. L. HAASIS.*

THERE NOW I HAVE "CLEAN FORGOT"
TO SAY WHAT WAS ON MY MIND WHEN
I STARTED OUT, NAMELY, MERRY X MAS,
MERRY X MAS, MERRY X MAS, AND HAPPY
YEARS TO COME. Always yours. *A. L. H.*

sent out to the trade in greeting. "Dixon" goods and business are always Haasis' first thought.

QUESTIONS AND ANSWERS.

Brass Hinge Mixture.

We wish to use a cheap brass mixture for brass hinges which have to be polished and nickel plated. The metal must be able to stand some bending without breaking and the casting must run up full to the pattern. We are using a 2 and 1 mixture, but find this too expensive for the class of work.

The following mixture will be satisfactory for your purpose. Copper 57 lb., zinc 43 lb., aluminum 4 oz. The mixture should be cast at a low heat. It will stand bending, but if you find that it is too stiff, you can add less zinc. The aluminum is necessary in order to cast the mixture.

Separating Gold From Copper.

What is the best way to separate the gold from the copper and other metals, after cutting down different karats of rolled gold plate scrap?

Treat the scrap with equal parts of chemically pure nitric acid and water. This will dissolve out the copper and leave the gold. Wash and filter off the thin films of gold remaining, and dissolve in aqua regia to form gold chloride.

Steel-Gray on Brass.

Can you give me a formula for a dip for coloring brass a steel-gray oxidized finish?

Take four ounces of iron filings and dissolve them in a gallon of hydrochloric acid. Add four ounces of white arsenic and warm the solution till all is dissolved. The dip is used at a temperature of 150 deg. F., and the goods should be lacquered.

Core Sand Binders.

What core sand binder is used for brass valve cores which are removed from castings by blowing out in water, leaving the casting clean, and of good color?

Several materials are in general use for core binder in making valves, among others, flour,

oil and molasses water. It really makes little difference what is used as the function of each binder is the same. Most foundries seem to use too much binder, thus generating a large amount of gas which is apt to cause a blow. If you are troubled with the sand adhering to the casting, it may be because the sand is not suited for the work. Look for this before changing binders, if you have one that works well. Sand wet with molasses water is excellent as a core as it generates but little gas, but it gives a rather fragile core that requires careful handling. Oil has the advantage that the core does not absorb moisture on standing, but it appears to make too hard a core for some purposes. You will find that molasses water will give best results.

Strength of Solution for Barrel Plating.

We have just installed a rotary plating barrel for plating brass nuts, washers, etc. We have tried both cyanide and acid copper solutions with but little success; the acid copper stands 15 to 18 Be. while the cyanide stands from 8 to 10 Be. We can get from 2 to 60 amperes on our regular vats and these solutions give satisfactory results. We do not know whether the solution is strong enough, or what is the trouble.

In order to do barrel plating, the solution should be as strong as possible unless you have a high voltage dynamo. We should say that your solution is too weak. The cyanide copper solution should be used, as acid copper is not suitable for this work. Have it stand at about 18 or 20 and run a little warm and you will have no further trouble.

Bright Silver Plating.

What must I add to my silver plating solution in order to produce a bright, hard deposit?

Carbon sulphide is the chemical added, ten drops to one litre being sufficient. Shake thoroughly after adding. After the solution has settled for a little while, drain off the clear liquid and you will obtain the solution of car-

bon sulphide of which 18 grams are added to 45 litres of the plating solution. From time to time more of the solution of carbon sulphide must be added. The deposit is smooth and is polished without difficulty.

Soft Metal for Ornaments.

We enclose sample of small metal ornament and wish to learn what composition of metal would be most satisfactory for this class of ornament. We wish to have something slightly more solid than the sample, but about the same thickness as the ornament cannot be used for our purpose owing to the thickness of the article.

The mixture needed for your purpose is known as Hoyt Metal composed of 87 parts lead, 13 parts antimony. If this mixture proves too brittle, cut down your lead and add tin until you get exactly what you desire.

Casting Silver Vase.

Would it be possible for me to make a plaster of paris longitudinal sectional mold of an engraved bronze vase, and cast the mold with molten silver made from Mexican coin silver? I also wish to gold plate certain parts of the engraving. What is the best gold solution to use for this purpose? I do not know the percentage of copper in the Mexican coins, but I have been told that it is impossible to cast silver because silver contracts in the molten state.

There should be no difficulty in making the vase provided you make the plaster mold right and pay special attention to the gating. You should have no trouble in the casting cracking as the mixture is 90 per cent silver, 10 per cent copper and casts well. Be sure to get all the moisture out of the plaster before pouring the hot metal into it. A much stronger mold will be obtained by mixing some magnesia, fine ashes, or powdered asbestos with the plaster and in this way you can bake the mold at a higher temperature to drive away the moisture without the plaster crumbling.

For the gold solution, the following will give you a good rich color. Sulphite of soda $1\frac{1}{2}$ oz., phosphate of soda 8 oz., cyanide of potash 6 dwt. and gold (as chloride) 3 dwt. and water one gal. Use asphalt paint in the background as a stop-off.

Low Brass Mixture.

We are enclosing a sample of what is supposed to be a yellow brass or dip metal casting. We desire to find out just what this is. Is it a manganese bronze, or just a 62-37-1 mixture with a little aluminum, and if so, how much. We wish to learn how to duplicate this metal.

The sample of metal received is not a yellow brass, but what is commonly known as green or low brass. To make the mixture use 75 per cent copper and 25 per cent zinc, and 2 per cent of lead if the castings are to be machined. Too much lead will make the castings turn dark in dipping. There does not appear to be any aluminum in the mixture, but if you wish, you could add 1-10 per cent in the following manner: make an alloy of 1 lb of aluminum and 9 lb. of zinc and add 1 lb. of this alloy to every 100 lb. of metal in the pot.

Bright Nickeling

We wish to nickel plate some small steel novelties and get a bright, light color by plating without the use of a mechanical plater. We understand that there is some salt or chemical which may be added to the plating solution to give a whiter result. Kindly inform us what this is and how much is needed to a gallon of solution.

The chemical you require for your purpose is boracic acid dissolved in hot water. Four oz. is required to every gallon of solution which should register 6 deg. Be. The work should be strung up on racks or hung in baskets and after plating should be tumbled in a mixture of soap water and sawdust.

Copper Depositing on Plaster of Paris.

We have an opportunity of copper depositing electric domes made of plaster of paris and we should like to have your advice as to the best manner of treating the plaster before plating. On smaller articles we have successfully boiled stearic acid through it and then covered the warm wax with copper bronze which we have found most satisfactory. In these large domes, we believe it will take considerable time to boil the stearic acid through. Can you tell us of any other way to treat the surface so that we can get the deposit to hold to the wax that will be more economical?

We consider that your method of soaking the plaster in boiling stearic acid cannot be improved upon. This process serves two important functions, namely, getting rid of air and filling up the pores of the plaster, thereby presenting a smooth, even surface upon which metal can be deposited.

Another method followed by some platers for this class of work is to soak the plaster in very thin shellac and allow to dry, then brush on or spray on the quick-drying varnish and when this varnish becomes tacky, dust with bronze powder. Allow to dry, then dip in clean water with a good overflow. This will float off the excess coepr and give a smooth surface on which to deposit. You will have to be very careful in this work to get the copper to deposit on the inside. As an acid copper solution does not throw into deep pockets very well, you may have to resort to a cyanide copper to start the work. As little free cyanide as possible should be used for the excess will eat off the thin film of copper from the surface of the plaster before the deposit of copper commences to form.

Nickel Plating Aluminum Mixture.

We are jobbers of aluminum castings and have some large orders for aluminum castings to be nickel plated, but are unable to get a good job of plating. Do you know of a good mixture of aluminum that will plate well, and can you inform us of the best method of nickel plating?

The plating of pure aluminum has, up to the present, not been satisfactorily performed commercially, but a mixture of 2-3 zinc and 1-3 aluminum is being plated in a fairly satisfactory way. To perform the operation, use an electric cleaner, then dip in a cyanide of mercury dip made in the following manner: dissolve $\frac{1}{4}$ oz. of yellow oxide of mercury and $2\frac{1}{2}$ oz. potassium cyanide in each gallon of water. Boil for a few minutes, then allow to cool and filter for using. After the work has been through this mercury dip, it should be flashed in a good copper solution and may then be easily plated.

A good deposit of nickel is only obtained when the liquid at the surface of the cathode is kept alkaline. A sufficient quantity of ammonia must be present and stirring is advantageous.

PRODUCTION OF MANGANESE ORE IN BRAZIL.

All the manganese produced in Brazil is shipped from Rio de Janeiro and Bahia. The most recent statistics show the following exports in tons: From Bahia, 1910, 10,900, none in 1911 or 1912; from Rio de Janeiro, 1910, 243,053; 1911, 173,941; and 1912, 154,870; average value per ton, f. o. b., 1910, \$7.31; 1911, \$7.23; and 1912, \$7.22.

From the end of 1912 to date no manganese has been shipped from here, as prices in foreign markets, it is said, have not been high enough to make the working of the Bahia mines profitable. The only three in this State are named "Pedras Prestas," "Sape," and "Onha"; all are owned by the same company and situated about 20 miles from the town of Nazareth, on an estuary of the Bay of Bahia. The latter two mines named are connected with the Nazareth Railway by a narrow-gauge line $5\frac{1}{4}$ miles long, over which the ore is hauled to the Nazareth Railway siding and dumped into railway cars, which carry it 14 miles to the town itself beside the bay. There it is put into sailing lighters and taken to the ship. From the other mine, "Pedras Prestas," the ore is also taken to the Nazareth Railway by a narrow-gauge line, down which the cars run by gravity, the empty trucks being hauled back to the mine by mules.

It is stated that the ore contains 43 to 49 per cent metallic manganese and would average about 45 per cent, and that an average analysis would be: Metallic manganese, 45 per cent; phosphorus, 0.016 per cent; silica, 3 to 4 per cent; iron, 3 to 6 per cent; moisture, 2 to 3 per cent.—Daily Consular and Trade Report.

An extensive deposit of graphite has been discovered at Manatee, 18 miles south of Belize, British Honduras in the foothills of the Cockscomb Range of mountains. According to a consular report, surface prospects indicate that the bed is a large one. Considerable heavy ore, as yet unanalysed, but pronounced to be lead ore, is also said to exist in workable quantities. The mine is easily accessible from the coast and the owner of the land desires to hear from American capitalists and operators interested.

THE AMERICAN ELECTRO-PLATERS SOCIETY IN 1914.

By WALTER FRAINE, Secretary, A. E. S.

The year 1914 for the American Electroplaters' Society has been one of progress and accomplishment. At the beginning of the year there were fourteen chartered branch societies. Two more have been added during the year; Bridgeport received its permanent charter in July, and Cleveland, at present working under a temporary charter, was organized in November. Every branch society has added to its membership during the year, and while the increase has not been so great as to excite remark, it has been gratifying.

Much has been accomplished during the year in education. Bridgeport and Newark branches have installed laboratories for the use of their members in making chemical and electroplating tests and experiments. Buffalo, Chicago, Rochester and Toronto have engaged instructors to give instruction in chemistry. The St. Louis branch has prevailed upon the Board of Education of St. Louis to provide a course in chemistry, especially devoted to electroplating, in the night schools. The Dayton branch has instituted a series of lectures on electro-chemistry and allied subjects, the lecturers being experts in their respective fields. Many of the members have taken courses in chemistry in the night schools of their respective cities. All of this is bound to result in our members becoming more efficient in their profession and more valuable to their employers and themselves.

In the meetings of the branch societies, papers have been submitted on the various problems, which like the poor "are always with us". Many of these papers have been of great value and through our official organ, "The Monthly Review", have been placed within the reach of our entire membership.

The great event of the year was the first annual convention, held in Chicago the first week in June. Its sessions, presided over by our past president, Mr. Geo. B. Hogaboom, were noteworthy for the constant attendance of the delegates and their attention to the matters under discussion. A large number of visitors attended the business sessions and the "round tables" held each evening. Legislation that will have a great influence on the society's

future was enacted. One important result was the changing of the official publication from a quarterly to a monthly, under the name of "The Monthly Review", and the elevation of Mr. H. E. Willmore to guide its destiny. The result shows that the delegates picked the right man.

The Information and Employment Bureaus, maintained under the secretary's supervision have been active during the year. Requests for information have been referred to authorities on the subjects inquired about, and disposed of to the satisfaction of the enquirers. An increasing number of manufacturers have applied for foreman platers and their needs have been supplied to their satisfaction. The usefulness of these two bureaus is becoming more evident each year.

The greatest accomplishment of the year, however, is the broadening of the spirit of fraternity within the society itself. The reserve which has been a characteristic of the old-time electro-plater is fast disappearing under the influence of the society. The members, realizing that to receive they must also give, are placing the results of their experience before their fellows, to the advantage of the profession.

And yet, with every promise the society has made for 1914 fulfilled, it has only been a year of preparation for the year to come. The year 1915 promises a great increase in prestige and usefulness for the society. It is expected that branches will be organized early in the year in Toledo, Ohio., and in Grand Rapids, Mich. These are in sight; others will follow; the impetus acquired in the year just ended will have its effect on our progress and advancement in 1915.

Crucible manufacturers have greatly improved their products during the past decade. It is not uncommon to find records of 48 to 50 heats on brass crucibles where formerly from 30 to 35 heats was considered excellent.

The addition of aluminum to the hot galvanizing bath has the following effects: 1. The production of oxide is lessened. 2. The zinc coating is reduced in thickness and is more uniform. 3. The bath gains in fluidity. 4. The coating is whiter, retains its color, is more adherent, has a more beautiful appearance and is free from discoloration.

FROM AMBER TO DYNAMO.

PART II. CURRENT ELECTRICITY.

BY H. E. WILLMORE, Jr., B. S.

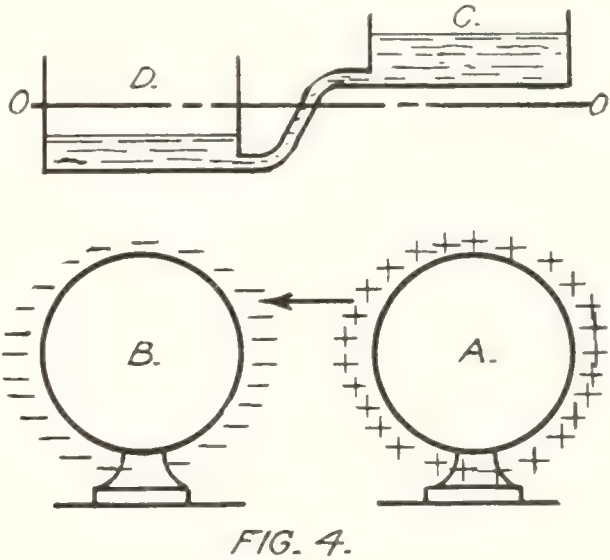
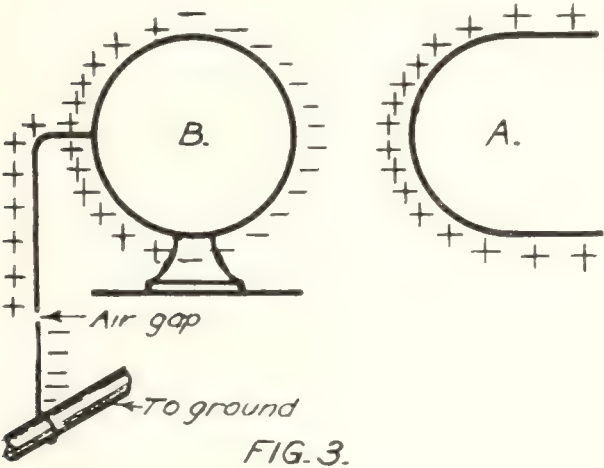
All articles in this series are copyrighted by the author.

This is the second of this interesting series of articles on the fundamental principles of electrical phenomena as applied specifically to electroplating study and practice. In this section, the author points out the relation between static and current electricity, the illustrations adding greatly to the demonstration. The articles in succeeding issues will present successively electrolysis, sources of electricity for plating, measuring instruments, electric circuits, types of motors and dynamos and electrical design of the plating room. We have already received congratulatory comments on the clearness of presentation of the subject matter by Mr. Willmore. The author is anxious that readers of the Brass World and Platers' Guide may obtain the highest benefit from this series and they are requested to send in questions on any points that may need further elucidation.

We have seen that static charges are capable of some motion and I shall here try to show under what conditions these moving charges constitute currents. Suppose we set up the arrangement of electrified bodies which we had in Fig. 1, but arrange B (conductive) with a conductor leading to ground as shown in Fig. 3. A, a glass rod strongly electrified by means of a silk cloth, is moved toward B. When A is close to B a spark will pass across

gap will indicate the passage of a current. B will then become practically neutral (without a charge).

The name "static electricity" implies electricity without motion, but in the above case under proper influence the charge moved. While such a charge is moving, it constitutes an electric current and the condition under



the air-gap, showing that the positive charge of B has been driven to the earth where the capacity for electrical charges is so great that it no longer exerts any influence. If A is now moved away from B until the two bodies have little influence upon one another, the negative charge will spread over the surface of B and along the wire to the air-gap, where it will attract a neutralizing positive charge from the earth and again the spark at the air-

which it will move is known as a difference of potential. Potential as considered in these articles, may be defined as electrical pressure, resulting from the difference in the electrical condition of any object as compared to the potential of the earth. A physical conception of potential and difference of potential is not always easily obtained and for this reason a few analogies may prove helpful. Referring to Fig. 4, A and B are two bodies charged

positively and negatively respectfully, and C and D are vessels containing water and connected by a pipe. A plane of reference O has been chosen so that the level of the water in C is above this or positive, while the level of D is below C and D is said to be negative. The usual plane of reference in hydraulics is the ocean level. The potentials of A and B are analogous to the levels of C and D, and the reference potential in this case is that of the earth which is taken as zero. A is positive and B is negative. If C and D were at the same potential (level), as is the case in Fig. 7, no water would flow from one to the other. In Fig. 4, however, a difference of potential exists (a difference of levels) which causes water to flow from the higher to the lower level. Likewise if A and B are con-

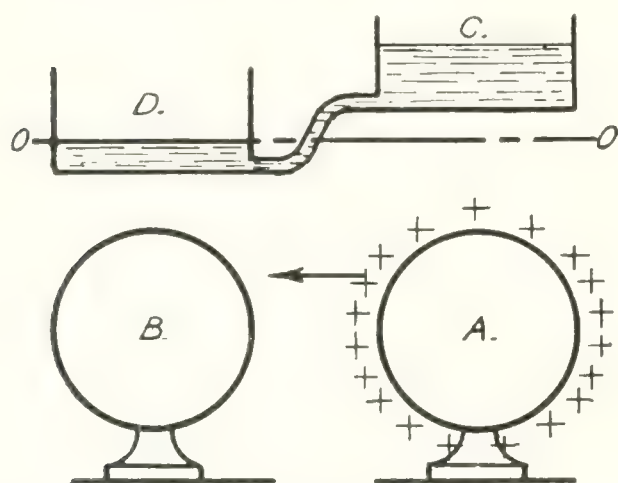


FIG. 5.

nected by a wire the difference of potential between the two bodies will cause all or part of the positive charge to flow from A, the higher potential, to B, the lower potential body. As this takes place the potential of A decreases just as the level of C is lowered, and the potential of B is raised until A and B are at the same potential. This resultant potential may be positive, negative or neutral depending upon the quantities of charges upon the two bodies. The charge of A may be just sufficient to bring the potential of B up to that of the earth in which case both A and B become neutral; it may be insufficient and both bodies will be negative; or it may be more than sufficient causing both A and B to be positive. This will be readily understood from a study of the levels and quantities of water in C and D.

Fig. 5 illustrates the flow of water from a vessel above the neutral plane or ocean level to

the neutral level, and likewise indicates the flow of a charge from a body of positive potential to a neutral body. It is apparent that unless the bottom of the vessel D has an unlimited area the level of D will be raised until the levels of C and D are the same. The same is true of A and B. If B has an infinite capacity for electrical charges both bodies will become neutral. This would be the case if A were connected to the earth, because the amount that the potential of the earth would be raised would not be appreciable. In all ordinary cases, however, the potential of B would be raised above the neutral until the potentials of A and B were the same as shown in Fig. 7.

Fig. 6 is intended to illustrate that two bodies may be both positively (or both nega-

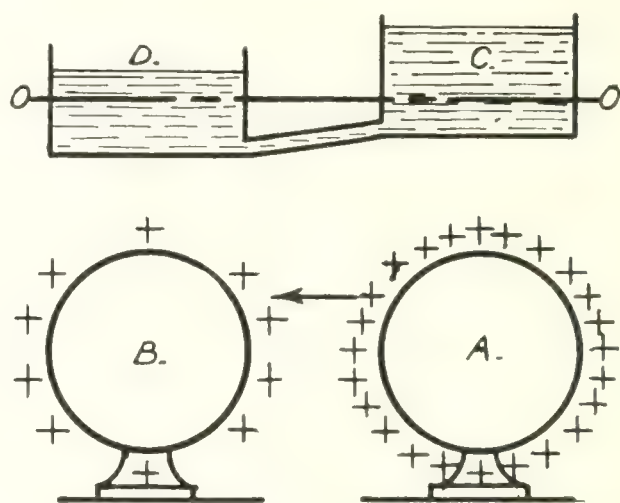


FIG. 6.

tively) charged and still be of different potentials so that a charge will flow from the more positive to the less positive or lower potential. The direction of flow in such cases is also illustrated by the analogy pictured in Fig. 8. In this figure A and B are barrels upon the decks of a ship and are at a positive potential, being located above the water line. C and D are barrels in the hold of the ship. Both are at a negative potential being below the water line, but since C is more positive than D a current of water will flow from C to D if the valve in the pipe is opened to give a free path. A study of Fig. 8 will show that the general direction of the flow is that indicated by the large arrow. This illustrates what has already been indicated, that a current will flow from the more positive potential to the less positive regardless of whether the two potentials under consideration are of the same sign

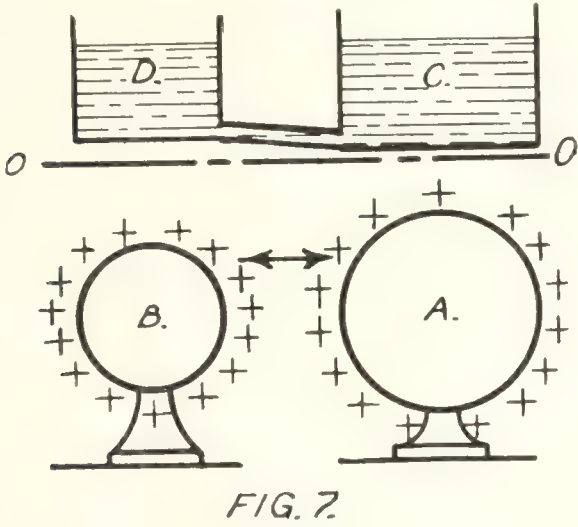
(positive or negative) or of different signs. Such rate of flow will always be proportionate to the difference and the value of the conductive medium.

Viewed in the light of the ion theory stated in Part 1 it may seem somewhat fallacious to speak of the positive charge moving, but this has long been the arbitrary direction of flow, and will be so considered throughout these articles. The facts which have been illustrated by these figures may then be stated as a law:—whenever a difference of potential exists and a path is offered a charge will flow from the position of higher potential to that

stored or are continually being used. The induction type of machine works upon the principle illustrated in figures 1, 2, and 3. In this machine charges are continually produced from an existing charge by the principle of induction, the potential of one terminal of the machine being raised and the potential of the other being lowered.

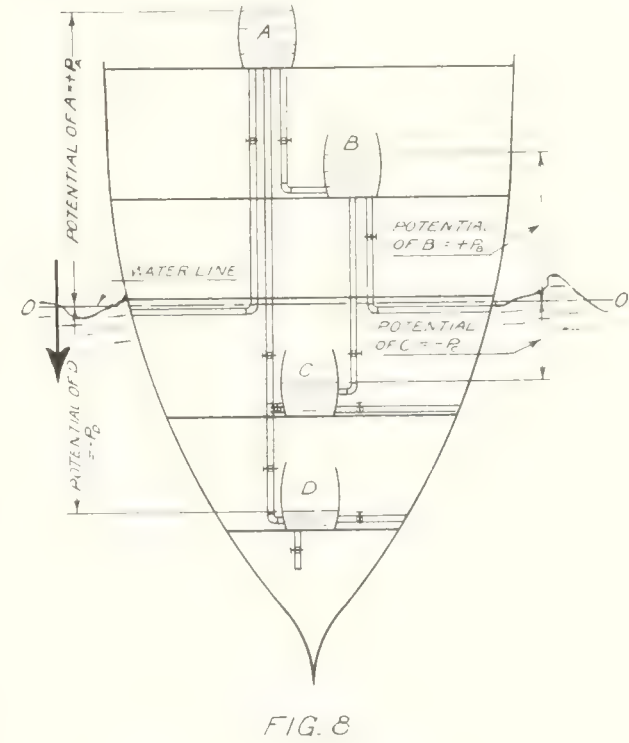
Electrolytic cells and dynamos are the two classes of devices for maintaining a difference of potential upon which the plater is dependent, and these in their various forms will be described after the principles which they involve have been thoroughly discussed.

The necessity of providing a path for an electric current has already been mentioned. All materials are more or less conductive. A table might be arranged similar to Table 1, placing the best conducting material at the head of the list. Much more practical, especially in dealing with such very low voltages as are used in the plating room, is a classification as conductors and insulators. These sub-



of lower potential:—i. e. from the more positive to the less positive position regardless of whether the charges at these positions are alike or different. From this we may conclude that the conditions necessary to bring about a continuous flow of charges which constitute a current, are (1) a continuous difference of potential and (2) an electrical path or conductor.

There have been numerous devices developed for maintaining a continuous difference of potential. These may be classed as thermopiles, static machines, electrolytic cells and dynamos. The thermopile is a device for converting heat energy directly into electrical energy, but because of its poor efficiency is of little or no interest to the plater. Its only practical use is that of measuring high temperatures. Static machines may be divided into two classes:—friction type and induction type. The friction type of static machine may be looked upon as a machine in which two materials are continually rubbed together and the charges produced are either collected and



stances which are conductors are characterized by the property which enables them when charged at one point to exhibit an electrification over the entire body. Insulators or non-conductors, on the other hand, when electrically charged at one point confine their charges to that locality. Some of the best conductors are the metals (headed by copper, silver and gold), carbon, and the solutions of a great many acids, alkalies, and their salts. Among

the best insulators are dry wood, paraffine, silk, sealing wax and various gums, shellac, rubber, gutta percha, glass, porcelain, mica and dry air. The behavior of conductors and insulators in general is affected by temperature and by the medium in which they are placed. Generally speaking, the insulation and conduction of solids are diminished by increase of temperature. Liquids, on the other hand, are as a rule better conductors when their temperature is increased. Thus glass which is ordinarily an excellent insulator becomes a fair conductor when heated to a semi-fluid state; copper becomes a poorer conductor as its temperature is raised; and salt solution is a better conductor when heated.

In order to obtain a conception of how a current of electricity is carried by a conductor from a point of higher to one of lower potential the author offers the following explanation, which is compatible with the theories of conduction by electrolytes, although open to much criticism. The molecules of all substances (the smallest particles of the substance which will retain the chemical characteristics of the whole) are supposed to be in motion, vibrating at an almost inconceivably high rate. According to the electron theory all these molecules which make up a body and the atoms which go to make up the molecules have negatively charged particles associated with them. In those substances known as conductors, these electrons are not closely bound to the atoms, and under proper conditions will move about freely; while in non-conductors or insulators these electrons seem to be bound to the atoms with which they are associated or, as has been suggested, they may be rotating about the centers of atoms like minute solar systems. In an isolated conductor we would expect, therefore, to find an equal distribution of electrons in all parts of the body, even though the whole conductor might be at some other potential than our zero, the potential of the earth. This must be true, because an unequal distribution of electrons would set up forces which would result in a rapid transfer of electrons from molecule to molecule until each of those molecules which at first carried a less number of electrons had picked up enough from its neighboring molecules with which it collided, to make its total equal to that of every other molecule. For example, suppose we have a wire several feet long, and to a higher potential than the other end. Then

suppose one end for an instant to be raised according to the electron theory the molecules at the higher potential end have fewer negative electrons. In moving about they come into contact with other molecules that have a greater number of negative electrons (are at a lower potential), and each two molecules coming in contact are at once brought to the same potential. In an infinitely short period of time these are in contact with other molecules at different potentials. The final result is an equal distribution of potential unless the wire is connected to a continuous source of potential. In this last case the negative electrons will continually pass from the lower to the higher potential end, and as was previously explained a current is said to flow from the higher to the lower potential, constituting a "continuous unidirectional current" or as it is more commonly known a "direct current". In drawing a mental picture of the conduction of electrical charges we must not, however, imagine that the transfer of charges takes any great amount of time because the speed of transmission of electric charges is only comparable to the velocity of light which is about 186,300 miles per second.

To be continued.

An interesting fact about graphite is that it differs from most other minerals in that it cannot be used twice, whether it be for crucibles, pencils, lubricants, or any other of its many uses.

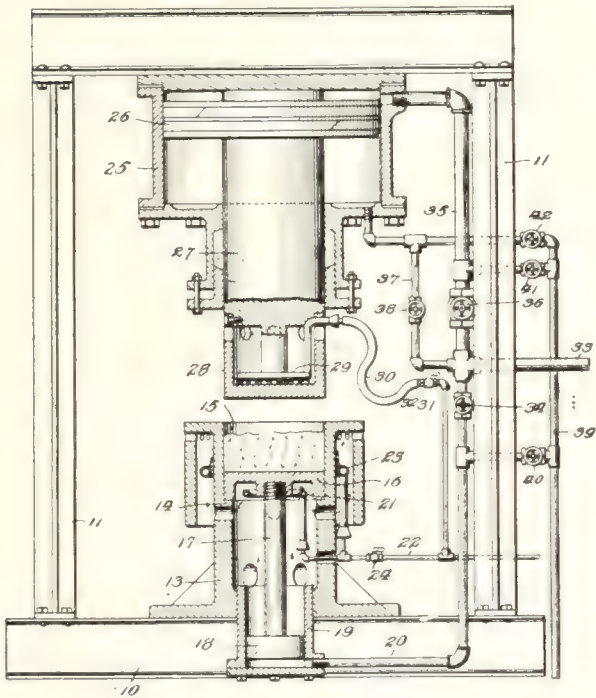
A new method of plating aluminum, described by E. Tassily in a French journal is as follows:

The aluminum is first immersed in a bath of boiling potash, then washed with lime water and dipped into a 0.2 per cent bath of potassium cyanide for a few minutes. It is then immersed in a bath of hydrochloric acid containing 1 gram of iron per litre. It is then nickel plated in the usual manner, the plating being, it is said, perfectly adherent. The deposit has a white matte appearance which becomes bright when scratch-brushed. When hammered or bent the deposit does not crack and the metal may be heated to the melting point of aluminum without separation of the nickel. The perfect adherence is considered to be due to the special condition of the aluminum caused by the small amount of iron in the hydrochloric acid bath.

PATENT NOTES.

Buffing Wheel.

The object of this invention is the production of an improved buffing wheel of a new material, lighter in construction and more durable than those hitherto in use. Ordinary scrap cork, such as is used in the manufacture of bottle stoppers, is employed for the pur-

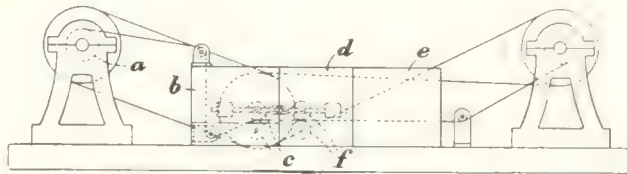


pose. The cork is granulated and simultaneously heated and compressed into the shape required, being bound into a homogeneous mass by the adhesive substances naturally present in the cork. After cooling, the wheel is surfaced with emery or other abrasives to be ready for use as a buffing wheel. U. S. Patent 1,118,822, November 24, 1914. Samuel S. Spero, New York City.

Process for Coating a Metallic Body.

Metallic resistance bodies are protected against oxidation and other destructive influences by coating with a surface layer of one or more of the noble metals such as gold, silver or platinum. This is particularly necessary in the case of resistance bodies which have

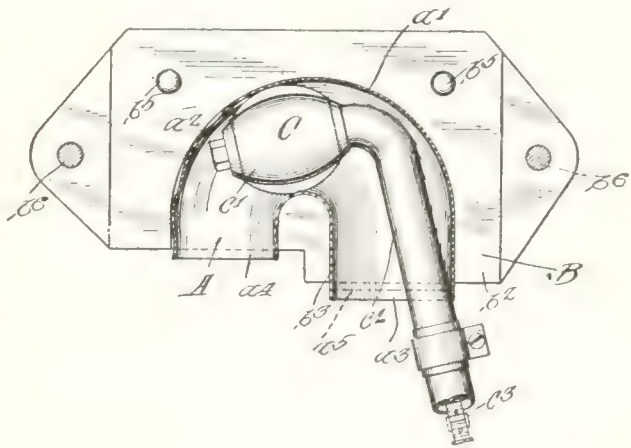
to be raised to a high temperature such as 1000 deg. C. for heating by radiation. The invention consists of an improved method of treatment in which the coating is rendered more complete and durable so as to form a permanent protection. The outer superficial layer



is impregnated with a colloidal solution of gold or other noble metal in oil so that the particles of the noble metal interpenetrate the particles composing the surface layer. U. S. Patent 1,121,169. Dec. 15, 1914. George Cooper, Birmingham, England.

Method of Forming Metal Tubes and Tubular Articles.

This invention relates to a method of making tubes by internal pressure economically and in such a way that duplication of such tubes is facilitated. It is more particularly applic-

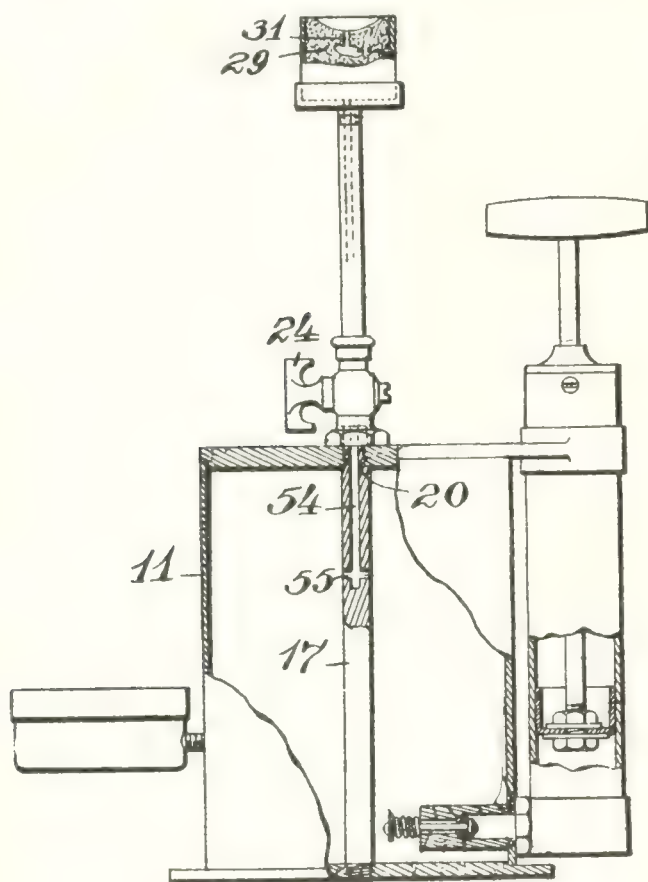


able to the production of musical instruments at a low cost and so that they may be automatically given the tone quality desired. In the manufacture, for example, of a return bend, the part is roughly formed but slightly smaller than the desired tube, and is then ex-

panded within a suitable die, to the dimensions required, by drawing or spinning the walls of the part outwardly into contact with the inner surface of the die. U. S. Patent 1,120,271. Dec. 8, 1914. F. A. Buescher, Elkhart, Ind.

Metal-Casting Machine.

This machine, which is particularly adapted for the purpose of making inlays for dental purposes, is of the type in which molten metal is flowed into a cavity in the investment ma-



terial of the mold. The apparatus embodies a vacuum chamber, a suction mechanism, a suitable indicator and flask support conveniently arranged with regard to each other. The pump is so affixed that its check-valve projects within the vacuum chamber, the valve being releasable after the removal of the pump. U. S. Patent 1,116,720. Nov. 10, 1914. J. J. McGuire, Newark, N. J.

Process for Coating Steel or Iron with Copper.

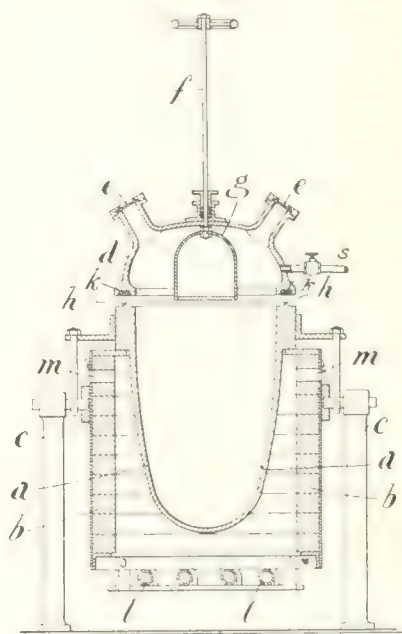
This invention relates to a process of producing a coated malleable and ductile ingot for the manufacture of rolled or drawn products, with a high tensile and compressive strength and with a coating of non-corrodible and electrically conductive material. A mold is

filled with molten copper, and the surface is allowed to cool forming a hollow shell. The interior molten copper is drawn off and the shell is filled with molten steel or iron. By heating the interior the two metals fuse and weld together, and they are then allowed to cool, the shell dissipating the heat to the surrounding media, and having a greater contractive effort than the core. U. S. Patent 1,115,870. Nov. 3, 1914. J. E. Scheaffer, Burnham, Pa.

Furnace for Melting and Alloying Metals in Vacuo.

The object of the invention is to provide a suitable furnace for melting, refining and alloying metals with a lower melting point than iron, particularly aluminum and its alloys, which are to be heated in vacuo, to prevent oxidation and to facilitate the diffusion of the component metals of the alloy.

A sheet or cast-iron melting chamber lined with fire-brick is provided with atmospheric



gas burners at the bottom, and contains a steel or cast-iron crucible, which has a cast-iron cover which can be sealed by atmospheric pressure so as to form a vacuum within the melting chamber. Eye-pieces of glass are also provided in this cover for viewing the contents, while a receptacle operated by a sliding rod through the top of the cover enables the operator to add various materials during the operation without breaking the vacuum. U. S. Patent 1,118,820. Nov. 24, 1914. W. S. Simpson, London, England.

SOME OBSERVATIONS ON NICKEL PLATING SOLUTIONS.*

BY DR. OLIVER P. WATTS.†

Electro-plating is a branch of electro-chemistry which has engrossed my interest more and more, and its problems furnish a most fascinating line of research. During a recent period I have been conducting a series of experiments upon certain phases of the deposition of nickel and I have considered the results of sufficient interest to display here.

The first topic to which I would call your attention is the composition of the anode. For many years it has been the practice of the makers of anodes in the United States to add to the nickel varying amounts of iron, carbon and tin, so that the resulting anode contained only about 92 per cent of nickel. The following formula for making nickel anodes is taken from one of the plating trade journals:—"Nickel 92 per cent, tin 4 per cent, old files 4 per cent." (Metal Ind., 1907, p. 116). Why old files are preferred to any other form of iron is not stated. A more recent article says, "The anodes are cast in varying degrees of purity, the average commercial anode consisting of about 92 per cent nickel and 8 per cent tin, while other grades, consisting of 85 to 89 per cent nickel and 11 to 15 per cent iron and tin, are especially adapted to certain work. A few are made of pure nickel free from alloy, but are too hard for ordinary purposes." (Foundry, 1913, p. 17).

The purposes of these impurities has been explained as follows:—"Commercial nickel anodes contain in addition to nickel, iron, tin, and carbon. These are introduced intentionally to render the anode "soft", *i. e.* so that it will dissolve easily in the solution during plating." (Brass World, 1911, p. 154). Analysis of samples of commercial nickel plate (J. Amer. Chem. Soc. 1917, 29, p. 1268) has shown the presence of 0.08 to 0.09 per cent of iron, and one writer (Trans. Amer. Electrochem. Soc. 9, 217) has ascribed the rusting of nickel plated articles to the presence of this iron. Whether this is true or not, these impurities in the anode are of no benefit either

to the solution or to the nickel plate, and their presence in nickel solutions should no longer be tolerated. For a number of years European platers have been using anodes containing 98 per cent of nickel, and it is time that American platers followed their good example. In a solution containing only sulphates these pure anodes do not corrode well, but the addition of one or two ounces per gallon of a soluble chloride remedies this trouble. Nickel, sodium, or ammonium chloride should be added to a solution in which pure anodes are used.

The little 25-gallon plating tank at the University was formerly equipped with the standard American anode, containing iron, carbon, and a trace of copper. A heavy brownish sediment of ferric hydrate continually collected in the bottom of the tank, and when standing unused copper was precipitated on the anodes and a scum of iron rust formed on the surface of the solution. Becoming dissatisfied with this state of affairs, I precipitated the iron, added some sal ammoniac to cause good anode corrosion, and replaced the impure anodes by sheets of electrolytic nickel, (obtained from the Orford Copper Co.) Electrolytic nickel anodes have now been used for seven years, and have proved satisfactory. At that time it was, I think, impossible to secure cast anodes of high purity in this country, but today the plater who wishes to avoid introducing impurities into his solution from his anodes is not confined to the use of electrolytic anodes, as cast anodes of high purity are now obtainable.

Another improvement in nickel plating which has come to us from Europe is the high-power nickel solution. It may be profitable to consider for a moment what constitutes a high-power nickel solution. It is not some mysterious chemical of wonderful potency, but is merely a solution containing much more nickel than the old style bath, and which therefore permits of using a greater number of amperes per square foot of plated surface without causing a burnt deposit. Since the rate of deposition increases directly as the number of amperes, the time of deposition is lessened proportionally.

* A paper read at the Annual Banquet of the Chicago branch, American Electroplaters' Society.

†Laboratory of Applied Electrochemistry, University of Wisconsin.

There seems to be a prejudice on the part of many platers against strong nickel solutions, as indicated by such statements as the following, taken from periodicals which regularly devote considerable space to plating. "A new bath composed of double sulphates and water not infrequently gives trouble from peeling in addition to the dark color, especially if the solution stands in excess of 6 degrees Beaumé. To remedy, reduce the density to 4 or 5 degrees and add the conducting salts." (*Foundry*, 1913, p. 106).

Question. Our nickel deposits come out dark gray and rough after $1\frac{1}{2}$ hours deposit. The solution stands at 10 degrees, and we have added single salts.

Answer. Your solution is too concentrated. In America solutions that register $5\frac{1}{2}$ to 6 Beaumé give the best results, provided the metal content of the solution is correct. Concentrated solutions produce dark deposits that readily stain, and often cause peeling." (*Metal Ind.*, 1911, p. 353).

Yet today many platers are paying 35 cents a pound for an imported mixture of unknown salts, making solutions having a density of 16 degrees, and obtaining extremely satisfactory results from these dense solutions.

I have here a good nickel deposit made at 18 amperes per square foot from a solution of nickel and magnesium chlorides having a density of 31.3 degrees. In thickness it is equivalent to a deposit for 20 hours at 3 amperes per square foot. If high density of solution were capable of ruining a deposit, this would be the worst sample of nickel plating which you have ever seen. It is time that platers recognized that poor nickel deposits are due to some other cause than too dense a solution.

I have tested but one of the high-power salts now on the market, but for a period of two months this has done all that the dealer claimed for it. I cannot conceive that a plater who has once tried this salt would ever use the old double sulphate solution, if he could obtain the price of this high power salt. It must be admitted that the expense is great, 100 gallons of solution costing \$70, instead of about \$7 for the double sulphate solution. Even if we grant that one tank of highpower solution will do the work of four tanks of the double sulphate, the ratio of costs is still over two to one against the high-power solution. Only when the composition of these salts becomes known, or platers discover equally good combi-

nations of salts themselves, will the high-power solution compare favorably with the old style solution as regards cost per unit output. When, however, freedom from peeling, and burning, and when in many cases a more satisfactory anode-corrosion is secured, even at present prices, the greater capital outlay required for the high power solution may be fully justified. There is, too, the possibility of using the new salts in half the concentration specified, thus cutting the investment in half, and running the solutions at 5 amperes the square foot instead of ten.

There are several methods of making a dilute solution do the work of a concentrated one. One method is to circulate or stir the solution, or to move the object,—any process that will break up the film of dilute solution formed around the object, and supply metal as fast as it is needed for deposition. Circulation and stirring of the solution have long been used successfully in the electrolytic refining of metals, but because of stirring up the sediment always present in plating tanks, or possibly for some other reason, these methods have not come into regular use in commercial plating. Where heavy deposits are necessary, as in silver plating, some means of shortening the time is desirable, and motion of the cathode rod has frequently been resorted to, thus allowing an increase of current density and a corresponding lessening of the time. This method is applicable in any case where a heavy deposit of metal is necessary, and its use has already been extended to the deposition of nickel.

But there is another, and more effective way of transforming an ordinary dilute nickel plating bath into a high-power solution—that is to heat it. For the past three weeks I have been experimenting with hot nickel solutions. From a solution containing 10 ounces per gallon of the double sulphate at a temperature of 194 deg. F. and a current density of 29 amperes per square foot a good deposit was obtained in twenty minutes, which would have required $3\frac{1}{2}$ hours in the cold solution at the usual current density of 3 amperes per square foot. Similarly the current density in a high-power bath of full strength at 165 deg. F. was increased at intervals to a maximum of 206 amperes per square foot, without spoiling the deposit; this is the equivalent of 19 hours at 3 amperes per square foot. To establish a record for the rapid plating of nickel a brass

tube $\frac{3}{4}$ inch in diameter was used as cathode, and rotated at 1000 R. P. M. Many trials were made at increasing current densities and although a current density of 1257 amperes per square foot was reached in one trial, the deposit was still excellent. Two minutes at this current density gives a deposit equivalent to 14 hours plating at 3 amperes per square foot, and in spite of this heavy deposit, 2 to 3 minutes with tripoli and rouge was sufficient to give it the polish of the sample shown. How much higher the current density can be carried under the conditions of these three experiments I am at present unable to say, and it really does not matter to the electroplater, as it has been shown that in a hot nickel solution the current density can be carried to such a point that the ordinary plating bath becomes a high-power solution. The efficiency of deposition on a rotating cathode at 625 amperes per square foot was found to be 99.8 per cent. But there is another result obtained in the hot solution which I regard as of more value to the nickel plating industry than rapidity of deposition—that is the softness, toughness and freedom from peeling of the deposit.

In the case of thick nickel deposits from cold solutions their hardness makes buffing difficult and expensive, they are more liable to peel than thin deposits, and the time required for their production is excessive unless a high-power solution is used. In view of these facts it is not surprising that in the past many platers have used altogether too light deposits. Much of this thin plating affords no protection to the underlying metal and is not even ornamental, for after a few months' use it wears off in spots and the articles look worse than if they had never been plated. Too much nickel plate is made to sell instead of to wear.

What could so much increase the popularity and extend the use of nickel plate as to have every bit of it which ever gets into the hands of the public put on to stay, and thick enough to protect iron from rusting and to last for years?

I believe that this can be accomplished by the hot nickel solution. Its use will enable the plater to produce a thick deposit in less time than is now required for a thin deposit. By heating the regular plating solution to 180 deg. F., or above, deposition can be carried on at twice or three times the rate of the present high-power solutions. By using a hot high-

power solution, current densities of 100 to 200 amperes per square foot may be used on stationary cathodes, or, since such great current densities as these are not needed in plating, the high power solution may be diluted to three times its original volume and yet be used at 20 amperes per square foot. The deposit from a hot solution is soft, never peels from a clean surface, and is quickly and easily polished even though it appears dull as it comes from the bath. This ease of polishing should result in a considerable saving in the time and labor required for buffing, and would partly defray the cost of heating the solutions. The heating coils should be made of lead.

It has long been known that hot nickel solutions give soft deposits and the following extracts would seem to indicate that hot nickel solutions have been tried and found wanting:

“Question No. 1283. What is the advantage of running a nickel solution hot and what are the disadvantages?

Answer. The advantage gained in using a hot nickel plating solution is that the nickel deposits faster and is brighter. In addition the nickel is apt to be slightly softer and more free from pits. Beyond these advantages a hot nickel solution has no other benefits. The disadvantages are the fact that the solution must be heated, and requires far more care and must be maintained at a constant temperature in order to obtain uniform results. Cold plating solutions are always used wherever possible, and in the case of nickel solutions it is generally considered that the slight advantage gained by using them hot does not warrant the extra labor involved. It is possible to obtain sufficiently good results in cold solutions of nickel.” (Brass World, 1913, p. 145.)

“Question No. 1324. What will happen if a nickel solution is run hot?

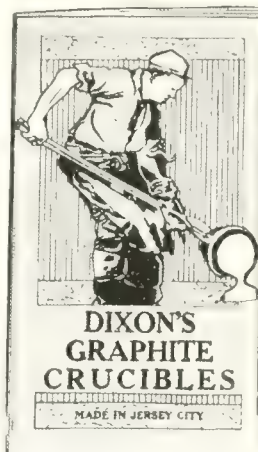
Answer. Nickel solutions can be run hot and give good results and soft deposits. They should, however, be used much weaker than when employed cold. It is generally found unnecessary to use them hot as the trouble of heating and maintaining them is more than the gain in quality. Hot solutions deposit nickel very rapidly.” (Brass World, 1913, p. 258.)

In general these statements agree with my experiments, that a hot solution yields a soft nickel deposit, and permits of more rapid deposition, but on the question of whether heating will pay or not we have come to opposite conclusions. This is a matter which cannot be

settled by argument, but only by trial on a small commercial scale. Cannot some local branch of the A. E. S. take up this question and carry it to a definite conclusion? Its potential importance merits an early and decisive trial by practical men.

It will probably be found that careful temperature regulation is not essential to success when the plating tank is equipped with an ammeter so that the plater knows what current he is using, although it may prove otherwise if he has to depend entirely upon the voltmeter in controlling the current. This leads me in closing to speak of the necessity of an ammeter, or ammeters, of suitable range so connected that the current passing in each tank may be read. It is the number of amperes per square foot of surface receiving the metal which determines whether the deposits will be good or bad; and not the volts across the tank. The voltage itself has no influence on the character of the deposit, and may have any value that is necessary to send the proper number of amperes to the objects which are being plated. The voltmeter is better than nothing since, with its aid, the plater can make a better guess at the proper adjustment of the rheostat than he could without it, but it is a poor substitute for the ammeter. The plater needs both voltmeter and ammeter for proper regulation of current and solutions. If a record is kept of the volts and amperes it will not only tell what current to use on a particular tank when partly, and when completely, filled with work, but it will indicate changes in resistance of the solution. To calculate the resistance of a plating tank read the volts and amperes, open the switch, or otherwise break the circuit for a second,—just long enough to get a reading of the voltmeter. Subtract the second voltmeter reading from the first, and divide by the current; the quotient is the resistance in ohms. Since the resistance diminishes greatly with increase of temperature, a change in the resistance of a solution does not surely mean a change in composition unless the temperature is the same as when the resistance was measured before. It is not necessary that there should be as many ammeters as there are plating tanks, for a single instrument may be arranged to read the current in any one of the several tanks. At the outset it might be well to purchase only one ammeter, and use it until convinced that it is a great help in plating before putting in a full equipment.

A NEW DIXON CRUCIBLE BOOKLET.



This reproduction of the cover design from a new edition of the booklet "Dixon's Graphite Crucibles" is merely suggestive of the valuable information contained in the sixteen pages that follow. In addition to a preface and the table of crucible sizes, information is furnished of steel melting crucibles, file crucibles, crucible covers, tilting furnace crucibles, retorts, bottom-pour crucibles, stirrers, skimmers, dippers, and self-skimming crucibles. Some good advice is given in the two pages of "For Oil Furnaces" and "General Hints." Foundry facings and a highly refractory cement for the repair of worn or cracked firebrick are also described. Altogether this little booklet is most worth while to the men interested in the subject of better foundry practice. A copy is gratis to those who take the trouble of writing to the Joseph Dixon Crucible Company, Jersey City, N. J.

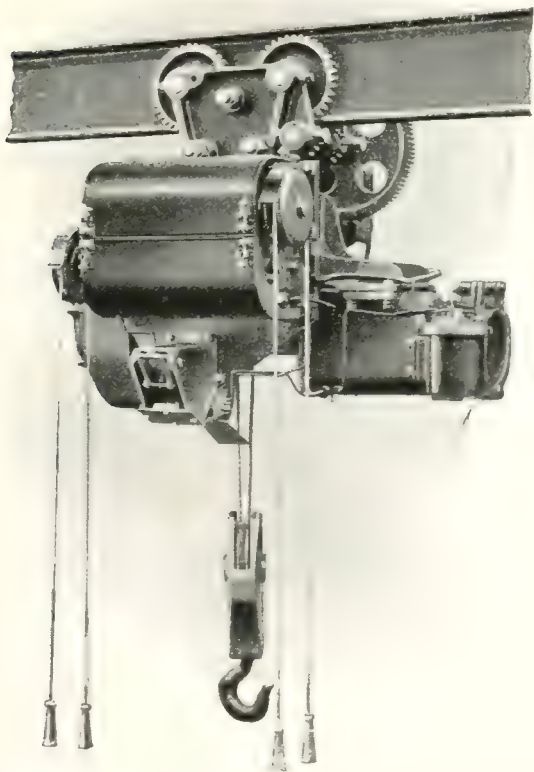
HARDENING AND WELDING COPPER.

Once again the problem of hardening copper, to such an extent that it will take an edge and may be used for cutting purposes, claims to have been solved. The latest inventor of a process for hardening and welding copper is Charles Bittner, of Stafford, Kansas (U. S. Patent 1,122,062).

The hardening compound used in this instance is composed of 16 oz. hyposulphite of soda, $\frac{1}{2}$ oz. sulphite of soda, 3 oz. No. 8 acetic acid (25 per cent pure acid) and 1 oz. powdered alum. The treatment consists in heating the copper to a good cherry heat, dusting a little of the powder over the surface, heating for about thirty seconds to burn this off, turning the metal over and repeating the operation until the entire surface has been so treated. In the second stage of the process, the same operations are performed but at a lower degree of heat. At this stage the metal is soft enough to be hammered into shape or welded. When this has been done, it is allowed to cool, and the process is completed.

THE APPLICATION OF THE
ELECTRIC HOIST.

After all the problems of producing things have been solved, and these are the most important apparently in the human mind, there still remains as a final factor of reduction of cost the problem of handling the raw materials and the finished products economically and rapidly. Wherever loads have to be moved which are too heavy for the handling of one man, there has to be considered the best ways of transporting this load from one department to the other, for true economy is found in short cuts and labor-saving devices, and real



profits are more often found in the savings between departments than in the difference between the cost of the manufactured product and its selling price. The electric hoist has proven to be a great money-saver.

In our illustration we show an overhead monorail hoist traveling on the lower flanges of a I-beam. Such a beam may be suspended from the roof of the building, or if the monorail is to cover yard surface, the runway may be supported by A-frames. Two or three collector wires are strung along the runway, supplying the hoist with electric current and enabling the hoist to perform efficient service immediately. The illustration shows a type of electric hoist which has given perfect satisfac-

tion. It is manufactured by the Pawling & Harnischfeger Co., Milwaukee, Wis.

This hoist, when equipped with magnets, enables the operator to handle the load alone. The average small hoists of this type need not be equipped with a cage at all and the man operating it can also attach the load. In this case, the hoist is operated from the floor. To give the reader an idea of the saving affected, a hoist of this type will replace from 3 to 10 men, depending on conditions and can be easily and quickly installed. A system of this kind is flexible and can be adapted to any plant requirements. Full details of the economies to be affected by the use of electric hoists can be obtained by reading bulletin 301 A, issued by the Pawling & Harnischfeger Co., Milwaukee, Wis. When writing, mention the "Brass World."

ALUMINUM ALLOYS.

Three new aluminum alloys have been recently patented by Wm. A. McAdams, Bay Shore, N. Y. Their composition is as follows:

1.	
Aluminum	100 parts
Copper	18 parts
Zinc	5 parts
Antimony	3 parts
2.	
Aluminum	100 parts
Silver	20 parts
Zinc	10 parts
Copper	5 parts
3.	
Aluminum	100 parts
Cadmium	30 parts
Tin	5 parts

The first of these is stated to be an inexpensive mixture, strong and suitable for casting; the second is a strong casting alloy, suitable for making doctor's instruments, etc.: while the third is a soft alloy which can be rolled into foil, similar to tin foil. The method of producing these mixtures is very much alike in each case, part of the aluminum being first heated to a high temperature, and the copper or cadmium added. The mass is kept agitated thoroughly and the silver and antimony are added, followed by the remainder of the aluminum. After cooling to a suitable temperature, the zinc or the tin is added, and the metal is agitated thoroughly before casting.

A BRIEF VISIT TO A BRASS ROLLING MILL.*

BY EDWARD J. GUTSCHE.

Brass is an alloy of copper and zinc, largely used for household furnishings, certain parts of machinery, and other ornamental and useful articles. In ancient history frequent allusions are made to the use of brass in the construction of musical instruments, vessels, implements, ornaments and even gates, but as no mention is made of its mode of manufacture or even of its composition it is doubtful if the brass of the ancients was composed of copper and zinc.

In the manufacture of brass on a large scale the proportions of copper and zinc vary according to the use to which it is to be put, with the copper ranging from 60 per cent to 95 per cent and zinc from 5 per cent to 40 per cent with sometimes the addition of lead and tin. The varying compositions are sold under different trade names.

In brass rolling mill practice where brass is rolled into sheet or drawn into tube, rod or wire form, it is necessary to first melt the several components, thoroughly stirring together and casting into a suitable form for milling. In our visit to the rolling mill we will therefore begin at the heart of the industry and first make an inspection of the casting shop. Here we will find the first point of interest in the making of the brass, namely that of making the mixtures.

In the earlier days the process of making brass was carried on by only a few men and was considered to be a very wonderful and secret process. The casters were thought of as being very expert workmen possessing the knowledge of secret formulae. Stories are told even today of how the casters put mysterious powders possessing secret virtues, into the pot; doubtless only a dash of salt.

Today all this has changed, and the caster is only considered as an ordinary workman performing his part in the manufacture of brass as directed by the foreman of the shop or by a chemist in charge of the alloy work, for modern methods of making brass mixtures are based on the work of the chemist in the laboratory.

The raw materials are tested for purity and all scrap is analyzed and classified as to varying mixtures. The charges are calculated and the amounts of the several constituents to be weighed are shown on a charge ticket given to the caster. The caster then makes his weighings as ordered and proceeds to melt his charge.

The crucibles used are of graphitic composition, holding from 180 to 240 pounds.

The furnaces in general use at the present time are of the pit type, either square or round, built in rows, either with the sets arranged back to back or as in some of the most modern shops, arranged along one wall of the building, thus allowing more room in front for mold pits and racks, scrap bins, etc. Natural draught is used, immense stacks being built giving sufficient draught for 100 fires.

The fuel used varies in practice, coal, coke, or mixture of both, being employed in different shops. Some foundries are successfully using oil furnaces and experimental work has been done with suction producer gas, and even with electrical furnaces. These are more or less in the experimental stage, although I understand they are being used in daily practice in some brass foundries. While the suction producer gas gives a sufficient heat to melt the charges, the length of time for melting the charge is about one-third longer than with the use of coke as fuel. As yet no entirely satisfactory gas furnace has been designed for general practice. If the gas furnace could be successfully used, it would have its advantages in lower metal losses and easier recovery of spills and drips into the fire, since no ashes are formed as in the case of coal or coke fires which require subsequent extensive working for metal recovery.

The molds used in casting brass for rolling consist of two pieces made of soft cast iron, known as front and back, which are placed together and securely banded. They vary in length from twenty-six to ninety-six inches according to width of mold and hold sufficient metal to make a bar of from 180 to 200 pounds in weight. The molds generally have a slight depression in the center, thus giving the cast bar a little greater thickness in the middle than

*Paper presented at the annual meeting of the American Institute of Metals, September 7-11, 1914, at Chicago, Ill.

on the edges. This allows of greater reduction in the first rolling without cracking the edges.

The work as carried on in melting a charge and pouring the heat is about as follows: The fires are kindled with charcoal and kerosene and a couple of shovelfuls of fuel added. The crucible filled with scrap is immediately put in and the copper ingots laid around the edge of the crucible, where it remains until heated to a red heat, when it is put into the pot with tongs. When the copper has entirely melted, the crucible is nearly filled up with scrap, leaving enough room in the pot for the introduction of the zinc. The top of the molten charge in the pot is covered with charcoal and sometimes in addition a handful of salt is used as a protective covering to the molten brass and to prevent excess metal losses. When the charge has come to just the right degree of temperature the zinc is introduced by means of tongs and the entire mass of metal is thoroughly stirred and allowed to come to pouring temperature.

While the charge is melting down, the molds are thoroughly cleaned and oiled with lard oil or mixture of lard oil, cotton-seed oil, fish oil or of any good carbon-bearing oil. The oil is used to prevent the cast bars of brass from sticking to the molds. When the hot metal strikes the molds the oil bursts into flame and slowly burns away, leaving a thin coating of carbon between the bar and the mold, thus preventing the hot metal from burning into the mold.

With the molds ready and the charge melted, the crucibles are drawn from the fire by means of crucible tongs. The metal is again stirred and the charcoal and dross on top carefully skimmed off. The pot is then swung to the molds and the metal poured in. The mold is filled to the top, forming there a gate or "riser" which is afterward cut off from the bar by means of large shears.

Mention might be made here of the fact that there are upon the market many compounds which are strongly advertised as good fluxes. In general brass foundry practice, however, no fluxes other than salt are used. The salt fuses, forming a good medium with which to collect dirt and dross and enable the caster to skim easily. The charcoal placed on top of the molten metal furnishes carbon, which, uniting with the oxygen, forms carbon monoxide. This is finally converted to carbon dioxide gas, which serves as a protective cover-

ing to the metal and prevents the formation of undesirable oxides in the metal.

The forms into which the brass is cast vary with the nature of the product to be made. While all sheet brass is first cast into bars of varying sizes, brass for seamless tubing is cast into round billets, as is also leaded brass to be extruded into shapes or rods. Brass to be drawn into wire is cast into rod form or into bar form if it is to be hot-rolled. Brass which is to be hot-rolled into sheet is cast in cakes.

A close and systematic control of the work in the casting shop is kept by the laboratory, samples being taken at intervals from each caster's work to make sure that he is carefully weighing the charges and thoroughly mixing the metal. Samples are generally taken from cuts just back of the gates. This is the metal which was at the bottom of the pot and therefore gives the best check on proper mixing.

Passing now into the rolling mill proper we find the bars to be rolled into sheets, coming from the casting shop with the gate cut off and cut to proper length and marked according to mixture. They are at once taken to the rolls and "broken down" cold, as are all of the rolling processes in the manufacture of brass.

The bars are broken down from about one and one-eighth inches thickness to three-quarters or five-eighths inch, in from two to three passes, according to width and composition of the metal. The metal is then placed upon large pans and drawn into the annealing furnace and heated to a cherry red heat, then drawn out and quenched. The metal is now ready for the process of overhauling, which consists in milling the surfaces of the bars to remove any dirt or foreign material. The metal is then rolled and reheated to again soften for further processes of rolling. The surface of the metal is brightened by dipping into acid, followed by washing and drying processes. All the scrap metal in the mills is again returned to the casting shop for remelting.

Passing now into the brazed tube mill we find the brass delivered from the rolling mill in sheet form of varying widths according to the diameter of the tube to be made. Here the sheet is shaped into tube form and the open seam is brazed. The brazing process consists of putting a mixture of brazing solder and powdered borax along the seam and drawing the tube slowly through a brazing furnace

where the edges of the seam are firmly brazed together. The tube may then be drawn to a finished gauge.

Stepping now to the seamless tube mill we find a somewhat different process of manufacture in that the tubes are made from a special shaped casting. Here we find the brass first cast into a round billet varying from $2\frac{1}{2}$ to 4 inches in diameter. This casting is heated to a cherry red heat and the first milling operation, which consists in piercing a hole through the center of the billet, is performed on the heated metal, differing thus from the sheet rolling where all the rolling processes were carried on cold. After the billet has been pierced, the following operations consist of annealing, cooling and drawing the metal on draw benches to a finished product. With tubes thus made without a seam, a product of great strength is obtained, of great service in any work requiring a brass tube to withstand a high pressure.

Next we pass to the brass rod and wire mill. Here we again find the process of manufacture beginning upon a special shaped casting. In the case of the brass rods the old process consisted of rolling, annealing and drawing the cast rods to a finished product. The more modern process, however, consists of extruding the rods from cast billets by means of great hydraulic pressure, and then giving the rod a draw for finish gauge and polish. The entire process is thus much simpler and faster than the old process of rolling and annealing cast rods.

Brass wire is made from cast rods which after casting are first put through a filing operation to make sure that no fins are left on the edges where the two-piece molds have come together. The removal of any fins or rough places on the edges is necessary in order to obviate the forming of any laps in the rolling which might cause slivers on the wire in the subsequent operations of drawing. Brass wire of all gauges corresponding to copper wire is made, which is a good illustration of the good working qualities of the alloy. In some of the present day methods, brass wire is also made by hot rolling brass bars into rod form and then drawing into wire.

Leaving the manufacturing departments there still remain the subsidiary departments, such as the wash room where brass is recovered from the sweepings, spills in the ashes, etc., the box factory, the tool room,

blacksmith shop, machine shop, and shipping departments.

We have now completed our brief visit to a brass rolling mill. Could a greater length of time be spent in a more complete visit to each department, much could be found of great interest in a more detailed inspection of the various operations, which in themselves would form subjects for interesting papers. Even in our brief and hurried visit, however, I think no one can help but feel as he steps out of the brass rolling mill and away from the noise of the heavy machinery that the process of rolling and drawing brass is indeed a wonderful and interesting industry. The glare of the molten metal, the value of the material being handled, the size and variety of the machinery and the detail which is necessary in the complete production must indeed leave an impression on the mind of the visitor as he again steps out from the busy scenes of activity as seen in a brief visit to a brass rolling mill.

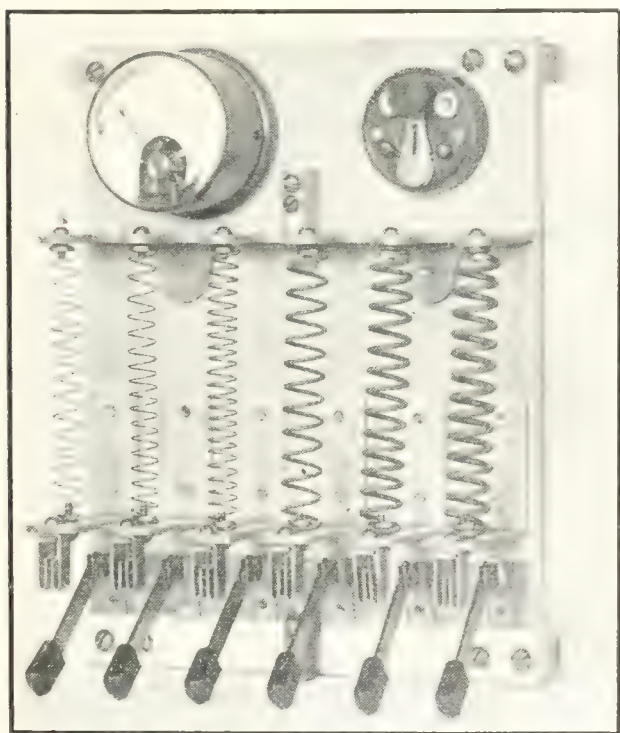
NON-CORRODIBLE METAL.

A British patent has been granted to J. Coup and E. Allbaugh, Clyde, O., for a non-corrodible alloy which may be used in the manufacture of such articles as knives, harness trimming, automobile trimmings, soda fountains, as a metal packing, and for piano strings and bells. The mixture consists of 69.13 per cent copper, 14.81 per cent nickel, 8.64 per cent zinc, 0.58 per cent lead, 0.06 per cent iron, 3.08 per cent phosphor tin and 3.70 per cent aluminum. When the alloy is to be used for making such articles as knives which are stamped or cut out, the phosphor tin preferably contains 6 per cent of phosphorus, but when the alloy is to be rolled, the proportion of tin is greatly reduced and may in some cases be omitted, the proportion of phosphorus in that case being from 0.053 to 0.76 per cent.

An English patent has been granted for a method of coating fabrics with metal, the material being especially applicable for optical projection screens. The fabric is first coated with a mixture of carriage varnish and boiled linseed oil and when this is nearly dry, aluminum or other metallic powder is dusted on.

HOW TO MAINTAIN AN ELECTRICAL BALANCE.

How to maintain a balance of any kind is man's perpetual problem. In walking we do it unconsciously, in day-time anyhow, no matter how conscious we may be of the effort at 2 a. m. under abnormal conditions. The maintaining of an electrical balance is the plater's pet problem. In his solutions there are constant changes taking place during the passage of the electrical current from anode to cathode and the adjustment of current strength is all essential to secure the plating action with the greatest degree of efficiency and suited to the varying products handled.



Such a balancing or adjusting device has recently been placed on the market by the Crown Rheostat & Supply Co., 1434. Cullom Ave., Chicago. This ingenious instrument comprises a voltmeter, voltmeter switch and rheostat. As shown in the illustration, these are mounted on one base, so that in adjusting the current in the solutions a correct knowledge of the voltage across the tank is obtained.

The dynamo voltage is secured by throwing the voltmeter switch to the opposite point, saving the time and trouble involved in obtaining this information where one common voltmeter is used.

The "Crown" rheostat with its large range of regulation is meeting with increasing approval from electroplaters and this new combination gives additional facility for certainty of operation. Risk of burning the work through overload has been eliminated by this apparatus. Those interested in current control can obtain special literature on the subject from the company.

AN OLD TOOL WHICH IS BEING APPRECIATED BY THE METAL INDUSTRY.

The importance of making a clean shipment of light brass or metal is shown clearly by the increasing sales of the K & B Co. hand magnet adapted for separating iron or irony stock from the higher grade metals.

Since the attention of the trade was called to this simple and efficient device, those who have bought the equipment report that disputes regarding shipments have been practically eliminated, prompt settlements have been made, and the labor of sorting greatly reduced.



The K & B Co., 25 N. Seventh St., Philadelphia, Pa., manufacturer of the equipment, states that each one sold brings in orders for several more; as every metal dealer, foundry, machinist, hardware dealer, or any one who handles metals, recognizes its practicability. Its durability has been proven by over 17 years' continued use. The equipment is furnished guaranteed to be satisfactory or no sale. It is adapted for use on either direct or alternating current (in the latter case a motor generator being supplied); or for such places as do not have power or lighting current available, it can be furnished complete with a battery. The K & B Co. has issued an interesting pamphlet describing the outfit which will be gladly furnished on request.

CHICAGO'S BANQUET CONVENTION.

The Chicago Branch of the American Electroplaters' Society broke all records in branch activity on Saturday, Dec. 12, 1914. On this day was held the third annual banquet and open meeting at the Grand Pacific Hotel. About 150 members and employers were in attendance and an excellent menu with a seasoning of music was provided. What Chicago branch ate and drank is a matter of hotel record but what practical good for the trade was accomplished is permanently and attractively set forth in the "Monthly Review" for December. H. E. Willmore has abundantly justified his title of Editor-in-Chief.

This affair was really a convention for the common good and the quality of papers delivered was markedly high.

The president of the branch, Oscar E. Servis opened fire with an inspired address, brimming full of the good fellowship for which he is noted, emphasizing the need of studying electrochemical phenomena, and urging employers to foster the associational growth of electroplaters.

Supreme President, Col. Jos. H. Hansjosten, in his inimitable way, distributed bouquets of praise and encouragement to his fellow workers. A perfect photograph of the inner man Hansjosten is presented in this extract from his speech.

"Let us believe that the future will be what we make it, with our minds set on success, refusing to even think of failure; our road plainly before us, ourselves steadily on our way, we cannot miss our goal."

Dr. Oliver P. Watts, University of Wisconsin, delivered the chief attraction under the title "Some Observations on Nickel Plating Solutions." He advocated the use of 98 per cent pure nickel anodes, the consideration of the advantage to be gained from high-power nickel solutions and the heating of nickel solutions.

"A Few Hints of Value to the Plater" was the output of Louis Schulte. Practical hints on gold, silver and nickel plating were given and valuable suggestions for the carrying out of experiments in electroplating with a view of standardization of effort. It is a fundamental paper and bound to set somebody at work.

S. E. Heuenerfauth dealt with "The Value of Voltmeter and Ammeter in the Plating

Room." He suggested checking methods conducive to greater efficiency in plating, the elimination of "burning" risks and increased ability to estimate amount of metal deposited.

"Nickel Pitting and Some of Its Causes" by Walter T. Donnelly was handled in an instructive way. The paper recorded actual experiments made and the causes of pitting and methods of prevention were given. Among the concluding "Don't's", "Don't overload your solution with cathode" is worth special remembrance.

"Finger Tips" should be read by every one. H. E. Willmore did it and no one is better fitted to talk on the value of indexing knowledge. His filing system for clippings, notes, etc., was outlined and should induce every one who has not already done so to start a 1915 private file and card index.

A typical letter from George B. Hogaboom (he needs no title; he is one) added to the enjoyment of those assembled.

The last meeting of the year was held by the Chicago branch in its hall at Randolph and Michigan, Chicago, on Dec. 26, 1914. It was a gathering of congratulation on the banquet success. The usual business was speedily transacted.

A vote of thanks was given to the Entertainment Committee for its splendid work. Ernest Lamoureux, the energetic chairman, performed a miracle of finance by declaring a balance in hand on the banquet accounting. Speeches were made by members and visitors and the sincerity of New Year wishes at parting gave evidence of the strong fraternal spirit existing in Chicago branch.

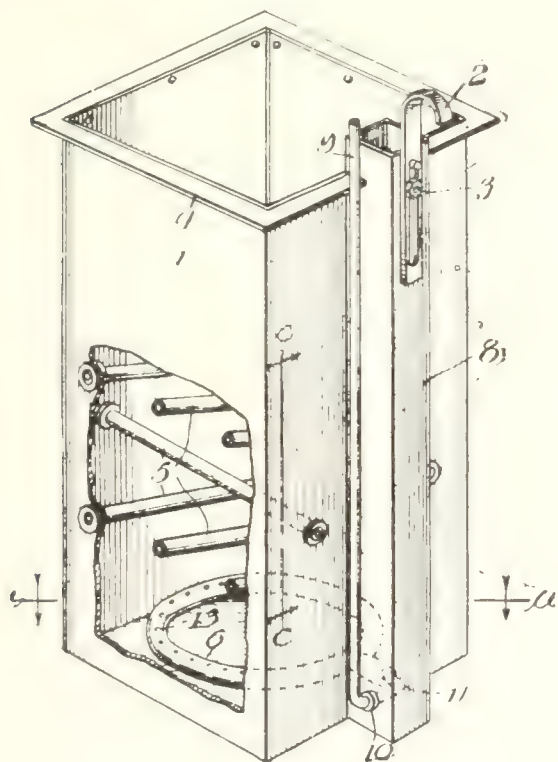
AMERICAN ELECTRO-PLATERS SOCIETY.

The Newark branch reports that the equipment for its laboratory is now in working order and members are privileged to use the same for experimental purposes at any time they may have at their disposal. A special meeting was held January 8th when a demonstration was given by Mr. Rojas of the Rojas Electro-Chemical Co., New York City, of the electro-chromatic process of coloring metals. A most interesting meeting was held and several members took part in the discussion which followed the lecture.

HEATING PLATING SOLUTIONS.

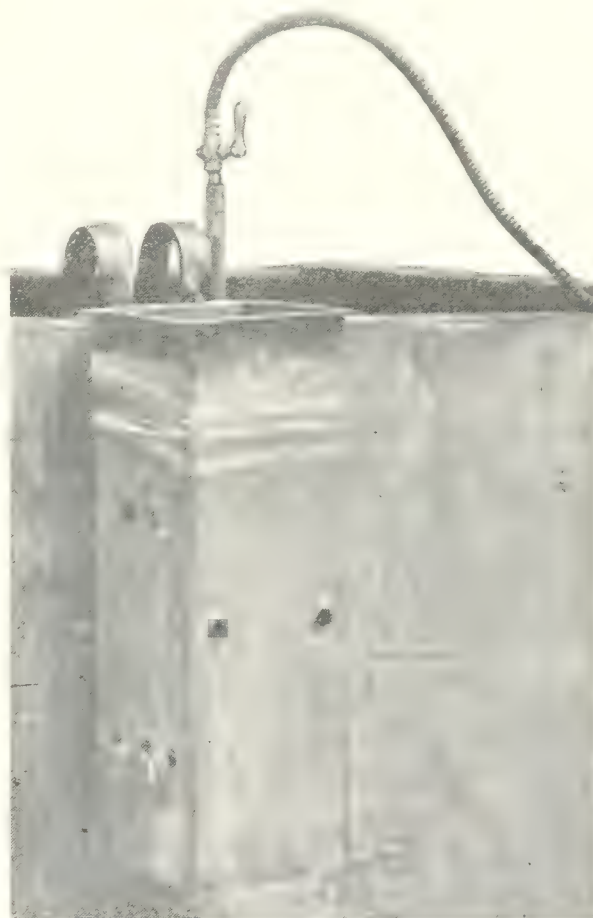
The greater efficiency of certain plating solutions when hot than when cold is known to most electroplaters. The excellent paper by Dr. Watts, presented at the Chicago banquet, calls attention to the advantage of hot nickel solutions and gives figures on experiments made which are well worthy of practical consideration. No matter what temperatures may eventually be established, it seems to be definitely recognized that the cooling of solutions below 70 deg. F. should not be permitted and the heating coils are used to restore heat to the solutions and maintain it. The varying temperatures of autumn, winter and spring affect the solutions correspondingly, especially where the plating rooms are not fitted up with heating installations capable of

Such a device is herewith illustrated. It is to be distinctly understood that it is not a boiler but a warmer or heater. It is constructed of sheet metal or cast iron, heavily tin-plated so that it will not affect detrimentally any solution. It can be plated to any desired metallic environment by hanging the tank for a short while on the cathode rod. The reader will note that the air shaft at the back obviates any risk to the asphalt coating of the plating tank.



Sectional View of Solution Heater.

maintaining a constant room temperature. Under these unfavorable conditions, a decided drop in temperature below the freezing point on Sunday, will bring about considerable losses of time on Monday morning in getting the plating room into perfect running condition. The desirability, therefore, of maintaining a normal heat in solutions under all weather conditions is evident, the only factors to be considered being the cost of such heat maintenance, and the elimination of the need of special attention to the heating apparatus.



New Solution Heater in Operation.

The heating is effected by a gas burner in the base of the heater. The solution fills the tubes which stagger through the metal container, each tube having an upward slant to promote circulation of the heated solution. The cost of operation is approximately 1-3 cents per hour.

In a recent test on a 300-gallon tank, the crystals of nickel sulphate of ammonia on the anodes disappeared in two hours and the peeling of the deposit previously noted on plated goods was eliminated by the use of the solution at a higher temperature. In plating brass or bronze, uniform color values were maintained by the maintenance of constant and

higher temperature, the deposits being brilliant enough in some cases to enable buffing to be dispensed with. This heater is easily transferred from one tank to another and can be hung in any part of a tank, preferentially on the anode side. It is manufactured by the Ele-Kem Co., 1510 Clybourn Ave., Chicago, and is the invention of Louis Schulte, the manager of the company, from whom further data can be obtained.

THE VOLTMETER AND AMMETER IN THE PLATING ROOM.

The voltmeter and ammeter in connection with the operation of plating solutions are coming more and more into practical use as they are of inestimable value to every plater.

By the proper use of these instruments the plater always has a correct knowledge of what is taking place in his solutions, particularly if each tank is provided with a volt and ammeter. If he has a fair knowledge of the number of square feet of work surface in any solution at any time he can determine immediately if he is getting the proper amount of deposit on his work by the readings on the ammeter. They also serve as a check on his solutions when not registering the proper amount of current passing through his solutions with the given amount of work surface in the bath.

With the voltmeter and ammeter applied to each solution and in a position where they are easily read, they are a great aid to the plater in making the proper adjustments of current with the rheostats.

Heretofore it has been customary to place the voltmeter and ammeter near the dynamo and frequently the voltmeter only connected to the dynamo mains which would only indicate the pressure the dynamo was generating. It is not as essential to know this as to know the voltage across each solution. In like manner the ammeter has only been used to show the number of amperes the dynamo was delivering. With the instruments connected in this manner the information obtained is of no practical value to the plater as it only indicates what the dynamo is doing.

With the voltmeter and ammeter on each bath the plater can determine instantly if he is getting the proper amount of current through

his solutions. They can also be used to check up any of the solutions at any time with a very simple test.

First secure a piece of sheet metal, say 12 in. x 12 in. x 1-32 or 1-16 in. thick, which would give approximately two square feet of work surface. Hang this in the solution, being careful that the distance between anode surface and work surface is the same on both sides. Then make a careful record of voltmeter readings also the ammeter readings. By keeping this record the same test can be applied after the solution has been worked for some time. If the readings are not the same as before, the solution has changed and requires some replenishing to bring it up to condition that it was when making the previous test. I would suggest making these tests in a small vessel of some kind, which can be used for testing various solutions.

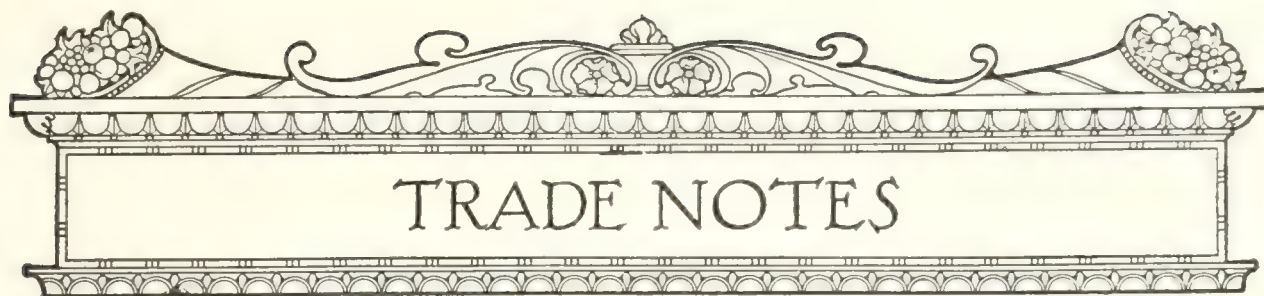
With these instruments connected to each solution the plater can turn out his work in a scientific manner, absolutely knowing the amount of deposit of metal on the work and often avoiding the return of unsatisfactory work on account of insufficient deposit.

Why not work in a scientific manner by having a complete knowledge of just what you are doing at all times, thereby bringing your department up to the highest efficiency and turning out work at a minimum cost?

S. E. Huenerfauth.

COMPOSITE METAL.

A British patent recently granted to the British Thomson-Houston Co., London, England, refers to a composite metal for making cooking-utensils, crucibles, water tanks, rooting, ovens or oven linings of ranges. It consists of an alloy of nickel and copper in which nickel predominates, united to one or both sides of a metal, consisting mainly of iron, by copper or an alloy consisting mainly of copper. This alloy is connected to the iron or steel by melting the intermediate layer of copper in a reducing or inert atmosphere, which may be provided by hydrogen or by an electric vacuum furnace. An example of this composite metal is given, consisting of 77 parts iron, 17 parts nickel, 4 parts chromium, and 2 parts manganese.



TRADE NOTES

The Darling Pump & Mfg. Co., Ltd., Williamsport, Pa., has completed a foundry, at an estimated cost of \$20,000.

The Ashland Foundry Co., Ashland, Ohio, has increased its capital stock from \$20,000 to \$32,000.

The National Brass Co., Grand Rapids, Mich., has built an addition to its factory to double its capacity.

The Aluminum Co. of America's plant at New Kensington, Pa., has received an order for 500,000 canteens to be used in Europe.

The Western Sheet Metal Works, Portland, Ore., will shortly build a factory for the manufacture of metal goods.

The Canadian Metal Co., Toronto, Ont., is about to build a shot tower 100 ft. high for making bullets.

The Regal Brass Co., Marysville, O., has increased its capital stock from \$75,000 to \$110,000.

The Metals Welding Co., Cleveland, O., has increased its capital stock from \$50,000 to \$75,000.

A fire occurred recently at the plant of the Smith & Wallace Brass Foundry, Woburn, Mass., makers of electrical railway supplies. The office building was gutted and a large stock building was destroyed, \$25,000 damage being caused.

The U. T. Hungerford Brass & Copper Co. has removed to its large 16 story building, Lafayette, Franklin & White Sts., New York. The building has been erected especially for the company to facilitate the handling of its heavy stock. Material approximating 5,000,000 lb. is able to be housed in the new edifice.

A fire recently did considerable damage to the building occupied by the Central Metal & Supply Co., East Lombard St., Baltimore, Md.

The Kinney-Rome Co., Chicago, Ill., manufacturer of brass and iron beds, etc., has opened a branch warehouse at Louisville, Ky., to facilitate the handling of its local business.

The Acme Metal Mfg. Co., Fort Madison, Iowa, will shortly be incorporated. The building is being put into condition and machinery is being installed with great rapidity.

The Everhard Mfg. Co., 524 Walnut St., S. E., Canton, O., which was recently incorporated for the purpose of manufacturing electrical appliances, metal specialties and novelties, is planning to double its plant.

The seven story factory building at 272 Kent Ave., Williamsburg, N. Y., owned by R. W. Read & Co., manufacturers of brass plumber's supplies, was recently damaged by fire to the extent of \$20,000.

S. Reubens & Co., 68 Cliff St., New York City, have been appointed general selling agents by the Crown Smelting Co., Chester, Pa., for the sale in the United States of their "Crown" brand of phosphor copper.

The Reliance Plating Company's plant, which is on the fourth floor of the Power Building, 26-42 West South St., Indianapolis, Ind., was recently damaged by a fire with a loss of \$5,000. The fire was attributed to spontaneous combustion among gases in the plant.

The present demand for antimony which is used in the construction of sharpnel has resulted in the re-opening of the mines at Lake George, York County, New Brunswick, Canada. This is due partly to the rise in price of the metal and also to better facilities provided for transportation.

The Kaufman Metal Works, Jacksonville, Fla., have erected a two-story galvanized iron building on the southeast corner of Second and Clarke Sts., valued at \$450.

E. G. Meeker who has been out of business during the past year, has started up again in Irvington, N. J., making a specialty of tampico, brass and steel scratch and wheel brushes.

The Central Brass Mfg. Co., 6103 Cedar Ave., Cleveland, O., was recently robbed by thieves who stole copper ingots valued at \$70 and which weighed 1990 lb. It is believed that they thought they had found a fortune in gold bars.

Fifteen thousand dollars damage was done to the four story building at 523 West Van Buren St., Chicago, Ill., occupied by electrical manufacturing concerns. The fire is believed to have been caused by spontaneous combustion in the plant of the Central Plating Co., located on the third floor of the building.

The Universal Polishing & Plating Co. has been organized by R. J. Marks, M. P. Marks, J. J. Ahern and F. Ahern, and has located at 355 Trumbull St., Hartford, Conn., having purchased the polishing and plating equipment of the Pope Mfg. Co. The company is now open for business, and is prepared to do polishing, plating, buffing and refinishing of metals at reasonable prices, having one of the best equipped plants in New England.

The new Chicago factory of the Celluloid Zapon Co., located at 45th and La Salle Sts., Chicago, Ill., under the management of Frank P. Davis, opened for operation on January 1st. A full line of lacquers and lacquer enamels as well as all other goods manufactured by the company, is carried in stock at the branch factory, insuring prompter service and shipment to western companies than has been possible in the past. Mr. Davis will give all matters his closest personal attention and is willing to assist firms desiring any special finishes by communicating or by personal calls. Firms located in the states of Illinois, Indiana, Iowa, Kansas, Minnesota, Missouri and Wisconsin are requested by the firm to send future orders to the Chicago factory at the address given above.

A Federation of Associations connected with the Brass & Allied Industries has been formed in England with Sir Gerard Muntz as president and Mr. Eric Heathcote, Temple St., Birmingham, England, as secretary. The Federation will consider matters bearing upon the well-being of the industries as a whole and calling for co-ordinate action.

In the Youville shops of Montreal Tramways, Montreal, Canada, babbitt is melted in a down-draft furnace with a direct reading pyrometer. The mixture is composed of 83 1-3 per cent copper, 8 1-3 per cent antimony and 8 1-3 per cent tin. It is poured at a temperature of 675 deg. to 700 deg. F. within which range no segregation will occur when the mixture settles.

The Canadian plant of the H. Mueller Mfg. Co., Sarnia, Ont., has been awarded a large contract by the Dominion government for 70,000 brass arts to be used on shrapnel shells. The company is well equipped with the newest improved machinery for the manufacture of casting brass parts. Other recent orders received from the government were for brass water works goods, plumbing goods, etc.

L. C. Smith, of the L. C. Smith Co., Inc., 225 John St., Bridgeport, Conn., is to be congratulated on the fact that government contracts, reported to amount to \$2,000,000, have been obtained for his new alloy, which is to replace the copper used in cartridges, shells and marine fittings. The alloy is composed of aluminum and copper and has the appearance of gold, with the wearing qualities of the old Egyptian bronze. It is said to be non-corrosive and non-pollutable. The chief difficulty in making an alloy of this kind has been to get the two metals to fuse and amalgamate successfully. Tests are being made at the Brooklyn navy yard under the supervision of E. W. Bliss, with the view to using the alloy for making fittings water tight on battle-ships. Other experiments are being made at the U. S. Mint in Philadelphia, with regard to the substitution of the alloy for copper in one-cent pieces.

Mexican graphite and manufactured graphite (produced in electric furnaces) are both unsuitable for use in the manufacture of crucibles.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY.

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES.

New York—Meets fourth Friday of each month at Broadway Central Hotel, New York City, at 8 P. M. Secretary, Joseph Minges, 148 Schenk Avenue, Brooklyn, N. Y.

Rochester—Meets second Friday of each month at Hotel Rochester. Secretary, C. V. Haring, 306 Dewey Avenue, Rochester, N. Y.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets, Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th. and Spruce Sts., Philadelphia, Pa., 8 P. M. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Dayton—Meets first and third Wednesday at the Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 Madison Avenue, Irvington, N. J.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 1st Street. Secretary, Geo. J. Kutzen, 518 Alfred Street, Detroit, Mich.

Chicago—Meets fourth Saturday of each month at Western Building, Randolph and Michigan Aves. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Indianapolis—Meets twice a month on Friday evenings. Secretary, pro tem., J. C. Davenport, 349 Massachusetts Ave., Indianapolis, Ind.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, John G. Murphy, 71 Dingens Street, Buffalo, N. Y.

Milwaukee—Meets first Friday of each month at Eagles Hall, 137 Second Street. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Ave., Cincinnati, Ohio.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, H. H. Williams, 2134 Nebraska Ave., St. Louis, Mo.

Bridgeport—Meets on the third Friday of each month at the "Brass World" office, 260 John St., Bridgeport, Conn. Secretary, Nelson Barnard, 858 Howard Ave., Bridgeport, Conn.

BRANCH NEWS.

The Detroit branch purposes to give a banquet in the latter part of January, probably the 23rd or 30th, the date not yet having been settled.

The regular meeting of the New York branch was held on Friday evening, December 18th at the Broadway Central Hotel. A paper was read by Mr. Thomas Brown on the spotting out problem; this is to be published in the Monthly Review. Preparations are now well under way for the annual banquet which will be held on Saturday evening, February 20, 1915, at the Broadway Central Hotel.

The annual banquet of St. Louis branch will be held on Saturday evening, Jan. 23, 1915 at the American Annex. Plates will be reserved for members of the society, their employers and those interested in their work. Able speakers will present both practical and technical papers. We extend an invitation through these columns to all manufacturers employing foreman electro-platers to come or send a representative, and to all foreman-electro-platers, who are within reach of St. Louis. Programs will be furnished and plates reserved by addressing the secretary, H. H. Williams, 2134 Nebraska Ave., St. Louis, Mo.

The committee in charge of arrangements is: F. Rushton; G. Samkemeyer; P. Tressider; H. Tressider and C. S. Weygandt.

Members of the branch are being given the use of the McKinley High School laboratory and the services of an instructor on Saturday afternoons by the Board of Education.

The librarian, H. J. Richards, is arranging to have an exhibit at each monthly meeting, and showed a water rheostat at the December meeting. Mr. P. Tressider and E. J. Musick also exhibited various brass, copper and bronze finishes.

Platinum is often alloyed with iridium to increase its resistance to abrasion and the attack of chemicals. This alloy is known as hard platinum and is more expensive than the pure metal.

NEW CORPORATIONS.

The National Brass Co., Houston, Tex., has been organized with a capital stock of \$20,000. G. F. Cotter is one of the owners.

The American Brass Mfg. Co., San Francisco, Cal., has been incorporated by L. H. Handy, M. A. Whittle and others with a capital of \$25,000.

The Heimbrucher Metal Products Co., St. Louis, Mo., has been incorporated with a capital of \$5,000 by John H. Heimbrucher, Adele Neuport and William C. Heimbrucher.

The United Copper Co., Jersey City, N. J. with a capital of \$5,000 has been incorporated for the purpose of copper mining. F. Bien, Jr., Thomas Adam and R. L. Turk are the officers.

The Corbin Lock Co., New Britain, Conn., has been formed with a capital of \$50,000 for the purpose of manufacturing hardware. The officers of the new company are H. C. M. Thompson, C. B. Parsons and C. H. Baldwin.

The Smiths Falls Brass & Aluminum Foundry Co. Ltd., Smiths Falls, Ont. Can., has been incorporated with a capital of \$60,000 by John McEwen, James MacDonald, M. G. Henniger and others, to manufacture brass, bronze and aluminum castings, and other metal specialties.

The Pfeiffer Mfg. Co., Bedford, Mass., has been established with a capital of \$200,000 for the purpose of metal working. B. Derby, I. Pfeiffer, Jr., and L. Pfeiffer are the incorporators.

The Whitehead Metal Products Co., Boston, Mass., has been organized with a capital of \$85,000 by Charles F. Toppan, J. J. Whitehead and S. M. Terle.

The Mineral Specialties Co., Chicago, Ill., has been established with a capital of \$2,500 for the purpose of buying and dealing in metal burnishing compounds and metal polishers. Walter F. Sommers, W. H. Sommers, and Samuel M. Come are the officers and the company is located at 1206 Rector building Chicago.

NEW BOOKS.

OIL FUEL: Its Supply, Composition, and Application.—3rd Edition, Greatly Enlarged. The author presents the subject of oil fuel in the light of modern developments and inventions, which have made this form of energy widely available in recent years, and constantly extend its field of usefulness. Covers the subject systematically and exhaustively. 152 illustrations. 328 pages. 12mo. Cloth. \$2.25.

THE EXAMINATION AND THERMAL VALUE OF FUEL: Gaseous, Liquid and Solid.—Useful methods and appliances for the comparison and valuation of fuels, based upon practical and official experience during some years, are presented in workable form in this book. It will be found of great value to all who have occasion to test fuels. 8 plates and 63 figures. 278 pages. 8vo. Cloth. \$2.00.

MEMORIALS OF HENRY FORBES JULIAN—Member of the Institution of Mining and Metallurgy; Joint Author of "Cyaniding Gold and Silver Ores;" Who Perished in the "Titanic" Disaster. Written and Edited by His Wife.

This memorial to the pioneer mining engineer, whose work was often done in practically unknown and unexplored quarters of the globe, derives a pathetic interest from the fact that he gave up his life in the great Titanic disaster, to save those of women and children. Much of the book has been made up of original records, letters and journals, written in many lands by the subject of the sketch. It has, therefore, the interest attaching to records of pioneer travels. In addition it portrays in clear outline the character of a noble and manly man.—With portrait and plates. 311 pages. Cloth, gilt top \$2.50.

One of the most valuable properties of platinum is that it does not tarnish or combine with oxygen, even at a high temperature. Another most important and peculiar property is its power to absorb gases, particularly hydrogen. Sheet platinum will absorb thirty times its volume of hydrogen at red heat.

The Brass World & Platers' Guide

BRIDGEPORT



CONNECTICUT

VOL. XI.

FEBRUARY, 1915.

No. 2.

A Monthly Journal Devoted to the
Art of Refining, Alloying, Casting, Rolling, Founding and Electro-
Plating of all the Non-Ferrous Metals and their Alloys.

Published by the Brass World Publishing Co.,
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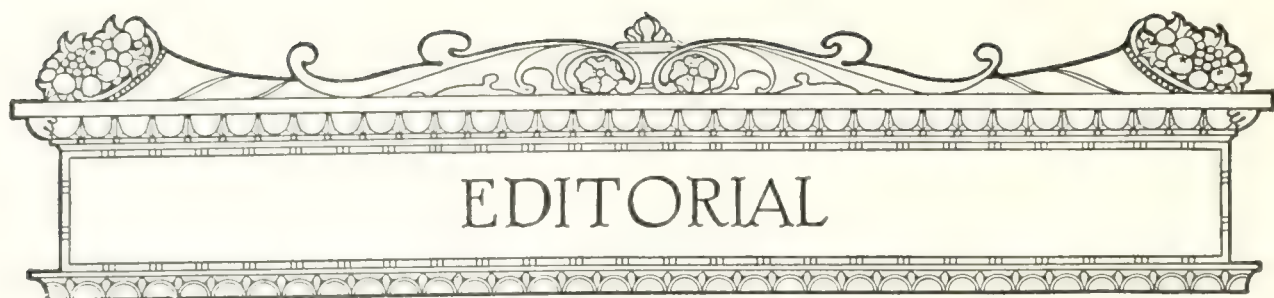
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HOW TO GET BUSINESS BY ADVERTISING.

Arlington Bensel, the aggressive sales manager of the Driver-Harris Wire Co., Harrison, N. J., recently gave a talk to the Alexander Hamilton Club on advertising problems, and some of the points made by him will be found peculiarly interesting at this time in our industrial history when the effort to obtain business must necessarily be greater than ever.

What is advertising? The speaker stated: "Effective advertising of a specialty is the comprehensive and forceful impression of the fact and feature of a commodity upon the mind of your field in such a manner as to agreeably attract attention, quicken interest and create desire."

The ten essential features for the construction of effective demand to create advertisements are quoted as—enthusiasm, knowledge of trade usages and conditions, possible application for the products, choice of advertising medium, trade mark, trade slogan or catch phrase, knowledge of human nature, truth, character, regularity and sequence.

This listing commences most excellently with enthusiasm. All the other nine points can be forgotten if enthusiasm is not present. Every man is both salesman and advertiser in the forms of industrial effort. He sells the labor of his hands and advertises his ability by the results obtained. Enthusiasm in one's life-work is as important as steam pressure to a locomotive. Mr. Bensel places its value at seven-tenths of success. Knowledge of trade usages and conditions is of great importance and 50 per cent of the troubles we experience after delivery of our goods to our customers is due largely to our misunderstanding of all the conditions surrounding the usage of the product and the conditions under which it is expected to give service.

The most important phrase in the entire speech was undoubtedly "agreeably attract attention". Too much business is lost through undue forcefulness and an attempt is made to coerce the prospective customer into buying on the basis of low price, immediate opportunity, or other strong-arm work which, though perhaps successful, does not leave a pleasant impression and causes the buyer to scrutinize the goods on arrival in a much more critical manner than he would in the first place. The complaint department eventually bears the loss occasioned through returned goods and the dissatisfaction as to quality expected, or demand for rebates on account of real or alleged imperfections.

"There is no excuse for the printing of anything in conjunction with an advertisement which is not an absolute fact." This quotation, while it may seem obvious, is a most healthy sign of business cleanliness. It is reassuring to the readers of trade papers to know that the manufacturers themselves are realizing the importance of conservatism of expression and the futility of unduly boosting the value of products which, when placed in service, fall far short of the claims made for them.

It is interesting to note the opinion of the speaker as to the choice of a medium. He says, "The trade paper offers the most satisfactory medium to the manufacturer selling practically to the consumer who is a manufacturer in a special industry." The company with which he is connected advertises extensively with many different trades and this pronouncement of the satisfactory service given by a trade paper in producing business is extremely gratifying. With forceful copy, embodying in an attractive way all the selling points in sequential presentment, trade paper advertising is a business-producing force which cannot be neglected by the manufacturer of trade supplies and equipment, nor can its service be supplanted by the activities of any other department of the company's industrial effort.

AN INTERESTING PROBLEM IN A WROUGHT-IRON RETINNING KETTLE.

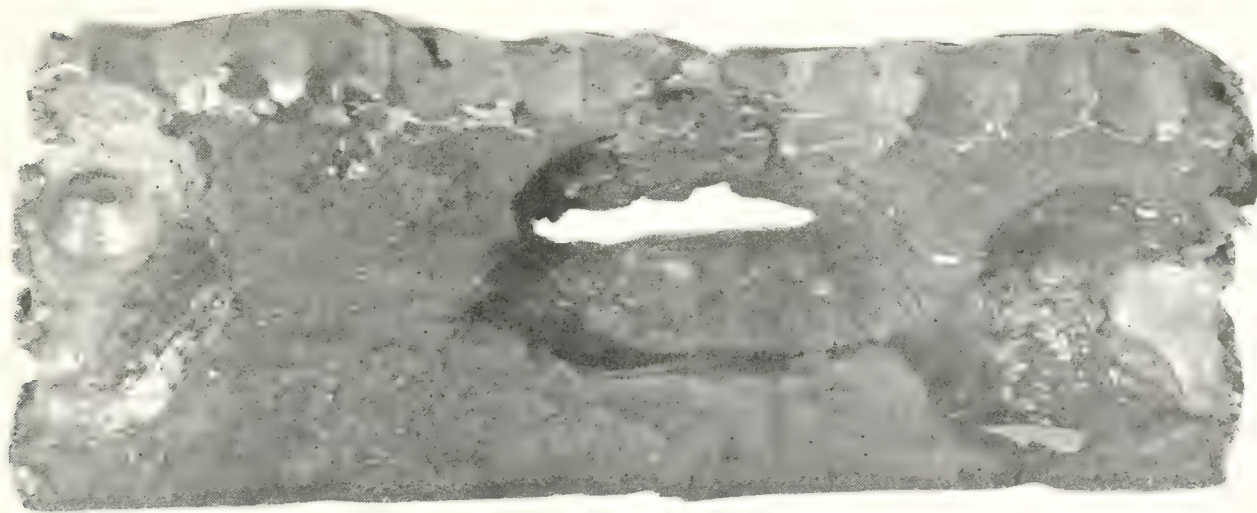
A subscriber to the "Brass World & Platers' Guide" has just forwarded to us this interesting letter. We will be glad to receive the opinions of our readers and experiences along similar lines.

"We recently had an experience here which may be interesting to you.

"We do a great deal of retinning, by which you will understand that goods that have been made from tin plate are given an additional coating of tin by passing them

articles which are soaked in it, it is very probable, in spite of our attempts to remove the greater part of this accumulation of tin every day by means of a shovel-like implement which we shove along the bottom of the kettle, there will always be more or less that cannot be taken away in this manner.

"Evidently, the heating of this kettle occasioned a warp, and this warp formed pockets in which films of tin gathered, and which could not be removed.



Portion of Bottom of Wrought-Iron Kettle. We Attempt to Show the Depths of the Three Pits. In the Center Pit this is Quite Marked as the Leak-Hole is Shown in Relation to the Upper Edge of the Depression.

through, first, a grease kettle, then into molten tin, and so on in the regular standard process of retinning goods.

"The grease kettle is an ingot-iron welded kettle, 30 x 44 in., and 24 in. deep, made of approximately one-inch thickness of metal. This kettle is heated by a coal fire, and on account of its size, there are two grates, the kettle being supported in the center by a bridge wall approximately 6 in. thick.

"Recently, the kettle began to leak into one of the fire holes and when the kettle was taken out, we discovered that at this point, the kettle had been eaten through in three pocket like spots, one of which was eaten entirely through, thereby causing the kettle to leak.

"When the kettle is in service, it contains molten beef tallow, and as this molten beef tallow strips more or less tin off of the ar-

"The matter was referred to the makers of the kettle, and to the steel mill which furnished the plate from which the kettle was made, and the metallurgist of the steel mill makes the statement that in all probability the small pools of molten tin had become superheated, and that tin when superheated will dissolve iron, and that this fact explains the failure of the kettle.

"This explanation, however, is not conclusive to the mind of the writer. The melting point of tin is from 446 to 449 degrees F. A thermometer introduced into the grease at our regular running temperature is about 500 degrees. If the grease is heated much above this point, there is danger of flash firing, and above this point the grease will boil over, and become very dangerous.

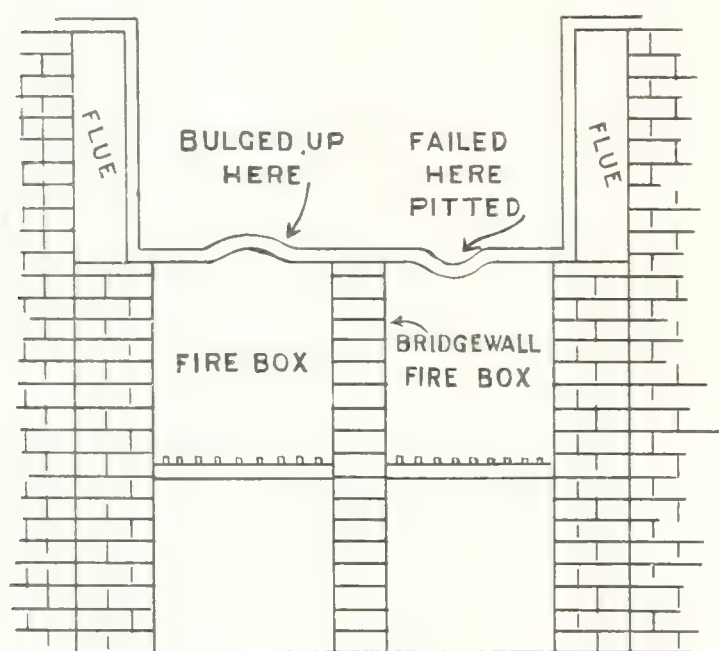
"Consequently, from this explanation you will see that we have a limit beyond which we must not go, and we know for a certainty, that during the time this kettle was in service, which was something over a year, no such condition arose at any time.

"To replenish the amount of grease in the kettle, possibly five to ten pounds are introduced slowly, so again there is no chance for a large accumulation of unmelted grease resting on the bottom and producing any bad condition.

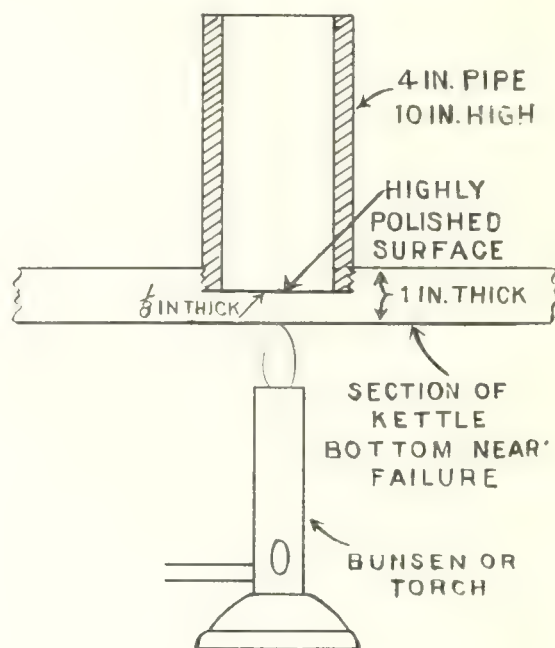
We have used both wrought iron and cast iron kettles, cast iron particularly, for upwards of 10 years to my knowledge, and as the company started business in 1836, I presume the practice went back considerably more than 10 years.

Our chief trouble with the cast-iron kettles is the fact that they crack after a year or two of service and have to be replaced.

The first wrought-iron kettle which was put in during my time failed because of the fact that the welded corners cracked, and the kettle



Showing the Kettle in Position and Location of Warping and Pitting.



Suggested Method of Attempting to Reproduce Pitting Condition.

"Possibly something along the lines of this experience has come to your notice, and the writer would be glad to have your advice whether or not you agree with the explanation for the failure as given by the metallurgist.

"This matter is one of considerable importance to us because we feel that if our practice in using a wrought iron kettle is wrong for the reason that the above condition might happen at any time, we should immediately change our practice to get away from this condition.

"The writer proposes to reproduce the condition under which this kettle failed, on a small scale, and attempt thereby to determine whether or not the statement as made by the metallurgist is correct. This he proposes to do unless you can advise him positively that molten tin will dissolve iron as claimed.

in question was a second wrought-iron kettle placed in the same stack. These two wrought-iron kettles are the only two that I have had personal experience with, and in the first one, I recall there was no internal pitting, although the kettle had seen service possibly 14 to 16 months."

If iron wire is used to support the anodes in a silver solution too high voltage must not be used. In a solution made of chloride of silver the chlorine, being the negative ion, is released at the positive pole and attacks the iron, forming chloride of iron. When the double cyanide of silver is used in a bath the oxygen of the water which is decomposed changes the iron into an oxide - Q. R.

A SHORT OUTLINE OF THE PRINCIPLES OF CHEMISTRY FOR ELECTROPLATERS.—VII.

BY ALLAN J. FIELD.

The following four metals—mercury (mercuric), copper, tin and lead—are grouped together, and are known as the second group. Lead is apt to appear in the second group, because hydrochloric acid does not precipitate it completely in the first group, lead chloride being somewhat soluble even in cold water.

Mercury (Mercuric).

For the following tests, use a dilute solution of mercuric chloride.

(1) To 5 c.c. in a test tube add a few drops of hydrochloric acid. There will be no precipitate, which fact readily distinguishes the mercuric compounds from the mercurous.

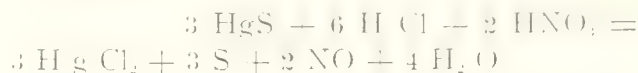
(2) To another portion add hydrogen sulphide water; a white precipitate will form; then, on the addition of more hydrogen sulphide, the precipitate will pass through different shades of color, from yellow to brown, and finally to black. The stable black precipitate is mercuric sulphide, HgS . The reaction is



The solution in the test tube is heated, then allowed to stand until the mercuric sulphide settles to the bottom of the tube. The liquid above it is decanted off, then about 15 c.c. of water is added and the precipitate is shaken up and allowed to settle out; the water is then poured off. The water is added so as to wash the mercuric sulphide free from hydrogen sulphide water as it will interfere with the following tests.

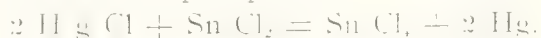
Divide the mercuric sulphide precipitate into three portions in test-tubes. To one test-tube add dilute nitric acid (: 1) and heat! the precipitate will remain insoluble, distinguishing mercuric sulphide from all other metallic sulphides (except those of gold and platinum). To another test-tube add caustic soda solution (15 per cent) and heat; the precipitate will not be dissolved. If hydrogen sulphide water is present, the caustic soda combines with it, forming sodium sulphide, which dissolves mercuric sulphide. To the third test-tube, add a mixture of nitric and hydrochloric acids (1 c.c. concentrated nitric acid to 3 c.c. concentrated hydrochloric acid), known as aqua

regia. The mercuric sulphide will be dissolved immediately, forming mercuric chloride. Sulphur will be liberated during the reaction, and this on further heating will be oxidized to sulphuric acid by the nitro-hydrochloric acid. The equation for the reaction is as follows:



Mercuric compounds can be changed to mercurous compounds by means of reducing agents such as stannous chloride. Dissolve 1 gram of stannous chloride in 5 c.c. concentrated hydrochloric acid; heat will have to be used. When it is all dissolved, dilute to 100 c.c. with water. (A portion of the solution should be saved for the tin experiments.)

To about 5 c.c. of mercuric chloride solution, add 5 c.c. of the stannous chloride solution; a white precipitate of mercurous chloride (Hg_2Cl_2) will form. The white precipitate will turn to a gray color if there is an excess of stannous chloride. The reaction is the reduction of the mercuric chloride to mercurous chloride which being insoluble is precipitated out as a white precipitate.



Copper.

A dilute solution of copper sulphate is prepared for the following tests.

(1) To 5 c.c. of the solution in a test-tube, add about 5 drops of dilute hydrochloric acid, then about 5 to 10 c.c. of saturated hydrogen sulphide water and heat. A black precipitate of copper sulphide will be formed. If the copper solution is not made acid the copper sulphide will remain suspended in the solution and cannot separate out; in such a condition it is known as a colloid. The addition of acid will prevent this. The reaction between copper sulphate and hydrogen sulphide is



When the copper sulphide has settled to the bottom of the test-tube, the liquid above it can be poured off. About one-half of the copper sulphide is poured into another test-tube and about 5 c.c. of a 5 per cent solution of sodium hydrate is added and the mixture is then

heated. The copper sulphide will not be dissolved. To the other test-tube containing the copper sulphide, add about 5 c.c. dilute nitric acid (1 part concentrated nitric acid to 1 part water) and heat. The copper will be dissolved immediately forming copper nitrate ($\text{Cu}[\text{NO}_3]_2$)



To another portion of the copper sulphate solution add cautiously a few drops of a very dilute solution of ammonium hydrate (5 c.c. concentrated ammonium hydrate diluted to 50 c.c. with water), which will precipitate a pale blue basic salt. If an excess of ammonium hydrate is added, the precipitate will be dissolved and the solution will become a deep blue color. The blue color can be destroyed by adding a solution of sodium cyanide.

Stannous Compounds.

In preparing a solution of stannous chloride hydrochloric acid is used to dissolve the salt, as water alone will decompose it, forming a basic salt which is not soluble. The stannous chloride solution used for the reduction of the mercuric chloride solution can be used for the following tests.

(1) To 5 c.c. add about 15 c.c. hydrogen sulphide water and heat over a Bunsen burner. A brown precipitate of stannous sulphide will be formed.

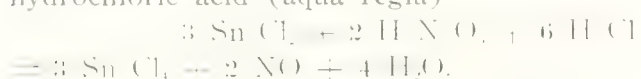


Stannous sulphide is readily soluble in concentrated hydrochloric acid, also in caustic soda solution. It is insoluble in colorless ammonium sulphide, $(\text{NH}_4)_2\text{S}$, (prepared by saturating 30 c.c. of ammonium hydrate with hydrogen sulphide, then adding 20 c.c. of ammonium hydrate and diluting with 50 c.c. of water).

(2) To another portion add a solution of mercuric chloride. A precipitate of mercurous chloride will be formed. (Compare similar test under mercuric reactions).

Stannic Compounds.

Stannic chloride can be prepared from stannous chloride by oxidizing with nitric acid and hydrochloric acid (aqua regia)



The nitrohydrochloric acid is made by taking 2 c.c. concentrated nitric acid and 6 c.c. concentrated hydrochloric acid and mixing together.

Measure out about 25 c.c. of the 1 per cent solution of stannous chloride into a small

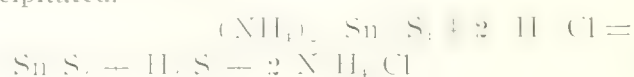
heater, add about 3 c.c. of the aqua regia mixture and boil for 5 minutes. As the solution will be considerably acid, which hinders the precipitation of stannic sulphide, it should be diluted to 50 c.c. with water. All of the tin ought now to be in the stannic form, as can be shown by the following tests.

(1) To 5 c.c. in a test-tube, add a few drops of mercuric chloride. No precipitate should form. If there is one, some of the tin is in the stannous condition. (This test quickly distinguishes between stannous and stannic).

(2) To another portion of about 5 c.c., add 15 c.c. hydrogen sulphide water. A yellow precipitate of stannic sulphide (Sn S) will come down. Heat and allow to stand for a few minutes for the precipitate to settle. Pour off the liquid above the precipitate, then divide the precipitate into two portions. To one portion add about 5 c.c. of sodium hydrate solution (5 per cent). The stannic sulphide will be dissolved immediately. To the other portion add colorless ammonium sulphide which dissolves it right away, forming ammonium thiostannate.



If hydrochloric acid is added until just slightly acid, the stannic sulphide will be reprecipitated.



As the reactions for lead have been given already in article 6, they will not be again repeated.

SALT WATER GILDING SOLUTION.

The original solution for salt-water gilding, as patented by Berthoud in 1860 consists of the following:

Water	1 gal.
Yellow prussiate of potash	4 oz.
Sodium phosphate	2 oz.
Potassium carbonate	1½ oz.
Sodium sulphite	1 oz.
Gold (as fulminate)	2 dwt.

Where the shade of gold is to be changed, by the addition of silver, a solution is made up, as above, except that 10 dwt. of silver as chloride, takes the place of the gold. Copper is also added in a similar manner to alter the shade of color.

THE CHEMIST AND THE BRASS FOUNDRY*.

By R. T. ROLFE, F. I. C.

PART I. CASTING OF GUNMETAL.

The object of this paper is to show the necessity and the value of the chemist in brass-foundry practice, if absolutely sure and safe lines are to be followed. Otherwise the founder is groping in darkness. That may seem a very sweeping assertion, but in many respects it is correct.

A case in point is a brass foundry engaged in Admiralty work and, consequently, chiefly in the casting of gunmetal, (Admiralty specification), that is, copper 88 per cent., tin 10 per cent., and zinc 2 per cent. The Admiralty further requires that the metal of the casting shall have a tensile strength of not less than 14 tons per sq. in., with an elongation of not less than 7½ per cent., on a 2-in. test piece. Assuming that the copper is melted in a crucible or air furnace, according to the quantity being dealt with, the tin, and lastly, the spelter, are added, the temperature raised somewhat and the metal poured. Without presuming to instruct anyone engaged in brass-founding how he shall cast gunmetal, it may be stated that if and when he has carried out the correct procedure, still he can by no means be certain that the metal will fulfil Admiralty requirements, that is, when working with brands of copper and tin of unknown composition.

Many founders find the greatest difficulty in conforming to the Admiralty specification. There is no need for the difficulty. I hope to demonstrate that success in casting depends first on the purity of the brands of metal employed, and only to a very secondary extent on the method of casting the metal, this is, of course, assuming that there is nothing wrong with the molding. It is only by testing the brands of metal, and rejecting all those which are found to be unsuitable, that success may be attained, and a rejected casting will be, as with us, a thing unknown.

First take the case of lead. Lead does not give one much trouble in gunmetal, because there is usually very little present. But the Admiralty specification stipulates that the proportion of lead present shall not exceed one-half per cent. Therefore one has to take steps

to avoid it. It is quite easy to exceed that amount if the materials used are not known and checked. How does the lead get there? There is often a lot in the tin. The following are analyses of three brands of tin that are on the market and used for the manufacture of gun metal:—

	A	B	C
	Per cent	Per cent	Per cent
Antimony	0.24	4.68	6.70
Lead	0.35	3.15	2.68
Copper	traces	0.22	0.36
Iron	nil	nil	traces
Tin (by difference) .. .	99.41	92.55	90.26
	100.00	100.00	100.00

If either B or C is used, over one-quarter per cent. of lead would be automatically added. By using C, the finished casting would contain only about 9 per cent. of tin and nearly 1 per cent. of impurities.

There is also a little lead in the spelter, but as the proportion of the latter is so small, the amount of lead added in this way is almost negligible.

When making gunmetal entirely from new metal, it is thus quite easy to avoid exceeding one-half per cent. of lead; but entirely new metal is not generally used, as it is necessary to utilize a certain quantity of metal returned in the form of borings from the machine shops. There is probably also gunmetal mixed with a certain quantity of white metal, in the form of mixed borings. This mixed metal is melted down, analyzed and finally mixed with the proper proportions of more copper and spelter to manufacture more gunmetal. There are a good many possibilities of mixing borings in even the best organized of machine shops and it is no uncommon thing to find that a small quantity of some lead antifriction alloy has got in somehow and finally helps to swell the lead content of the gunmetal.

I do not suggest that there is likely to be any very marked difference between gunmetal containing 0.3 per cent., and that containing 0.5 per cent. of lead, but when one is working to specification, it is necessary to know what is the degree of purity of the materials used. Incidentally, the presence of lead increases the liability to corrosion of the metal. Lead does

*Paper read before the London Branch of the British Foundrymen's Association, December 18, 1914.

not alloy with gunmetal, but, when the latter cools, separates out in the form of minute globules distributed through the mass, and being a weak metal, reduces the tensile strength and also the elongation. This weakening is very marked when the lead exceeds about 2 per cent. In some cases, however, where special strength is not required, large quantities of lead, up to 5 or 10 per cent., are added, with the production of a metal much more easily machined or filed. Such an alloy, if one may so describe it, is known as a "free-machining" alloy.

The main point to be demonstrated in connection with gunmetal is that no matter how closely the specification is adhered to, one cannot be sure of getting metal of a good quality, except under certain conditions. If, not knowing those conditions, any founder has not experienced trouble with Admiralty gunmetal, he is more lucky than he deserves to be. The chief condition for obtaining gunmetal of sound structure is that the brand of copper employed shall be of a certain degree of purity. This point must now be considered, and for this it is necessary to consider what happens when gunmetal cools from the molten state.

Probably most founders understand the term "solid solution." Just in the same way as salt can be dissolved in water and a solution of salt obtained, so one metal can be dissolved in a molten mass of another metal and a solution of the one in the other obtained; and just as a salt solution can be frozen by lowering the temperature sufficiently, and a solid solution of salt in water obtained, so can the second metal be made to solidify and still contain the first in solid solution; and by that is to be understood that the interspaces between the particles of the second are more or less filled up by the first, depending upon the amount dissolved.

Solid solutions of one metal in another are as a rule soft, strong and ductile, and accordingly are in general desirable constituents of the structure of any metal, if it is considered from the point of view of tensile strength. On the other hand, chemical compounds of one metal with another, like the compounds between metals and non-metals, are in general hard, weak and brittle. They are therefore undesirable constituents, again considered from the point of view of tensile strength. As mentioned, lead in gunmetal exists neither in solid solution nor as a chemical compound, but

as a free metal distributed in small globules throughout the mass. Being a metal of low tensile strength, it naturally weakens the structure.

When gunmetal cools from a molten state, the first constituent that falls out of solution is a solid solution of copper containing all the zinc, together with some of the tin, and it solidifies at 1,000 deg. C. Because it comes out of solution first, it is called the *a*-constituent, or first constituent. That body, quite a strong and valuable constituent, freezes, and the interstices, or the holes in the solidified network running all through the mass, are then filled by a second constituent, another solution of copper containing all the rest of the tin, and this second or *b*-constituent solidifies at 790 deg. C. The solid mass now consists of two solid solutions, the second of which, however, is not stable, but decomposes when the metal has cooled down to 500 deg. C., to form two more constituents, one of copper containing tin in solid solution, and the other of a totally different nature, a chemical compound, stannide of copper, corresponding to the chemical formula Sn Cu_4 . That stannide of copper is often called the eutectic, from the Greek, meaning "well-melting," because it is the most readily fusible portion of the metal. It is also called the *d*-constituent. Thus the *b*-constituent splits up into two, one of which is a solid solution, much resembling the first or *a*-constituent and often called secondary *a*, and the other the eutectic, stannide of copper.

The following table shows the changes taking place in the cooling:—

Above 1000° C.	Between 1,000 and 790	Between 790 and 500	At 500° C.	Below 500° C.
Molten Gunmetal	<i>a</i> -constituent solid. <i>β</i> -constituent liquid	<i>a</i> -constituent solid. <i>β</i> -constituent solid.	<i>a</i> -constituent solid Secondary <i>a</i> -constituent liquid, but soon solidifying. <i>δ</i> -constituent liquid, but soon solidifying.	All solid.

It must now be understood that very different distributions of the constituents are possible with the same composition of the metal, *i. e.*, 88 per cent. copper, 10 per cent. tin, and 2 per cent. zinc. If more tin is in solid solution, there is less present as stannide of tin and the metal will be stronger. In a good gunmetal the eutectic areas should consist of very small isolated patches distributed through the ground mass (see *a*, Fig. 1). If,

however, the eutectic areas are large and connected up to each other, the metal is much weaker. It is possible to tell roughly what will be the tensile strength of the metal by examining the micro-structure. There is another point about the eutectic that is very important, and that is that as it solidifies, it contracts and leaves small cavities. It is through those cavities that water leaks when a casting fails under the water test. Such a structure is shown in *c*, Fig. 1.

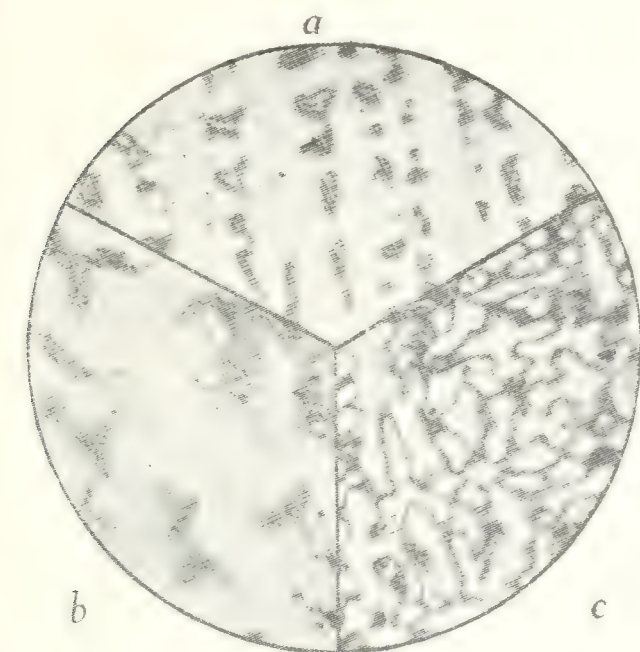


FIG. 1. COMPARISON OF ADMIRALTY GUNMETAL MADE FROM DIFFERENT BRANDS OF COPPER.
(a) Brand 1. - Very Good Structure.
(b) " 2.- Good Structure.
(c) " 3.- Very Weak Structure, showing Contraction Cavities in Eutectic.

The importance of all this to the foundryman is that with certain brands of copper it with certain other brands it is equally impossible to obtain a bad structure, with normal conditions of casting. From experience with seven different brands of copper, I find that the purer the copper the better is the structure, and the stronger the metal will be. Electrolytic copper apparently gives the best results in the manufacture of gunmetal. If the brand of copper contains about one-quarter per cent. of arsenic, the results will still be very good, but not so good as in the case of electrolytic copper. With other brands of copper containing a high proportion of arsenic, 0.75 per cent. or over, very poor results are obtained. It does not matter what brand of tin is used, and the structure does not appear to depend upon the tin. Certain brands of copper have been

found by us to be incapable of giving sufficiently good results for Admiralty purposes and have been rejected for that work.
The following table gives the average results of gunmetal cast from three different brands of copper, with also the average proportion of arsenic in each respectively:—

COPPER		GUNMETAL CAST FROM SAME			
Brand	Per cent. arsenic	Mean of	Average yield per cent.	Average ultimate breaking stress	Average ultimate elongation
			Tensile strength	Tensile strength	Per cent.
1.	traces	11 samples	11.2	16.6	14.7
2.	0.30	17.2 samples	10.7	15.5	12.4
3.	0.75	10 samples	11.2	14.4	7.4

Fig. 1 shows the structures of the metals made, while a typical analysis of a sample of each brand of copper is as follows:—

	Brand 1.	Brand 2.	Brand 3.
	Per cent.	Per cent.	Per cent.
Copper	99.83	99.49	99.04
Arsenic	traces	0.30	0.84
Tin	nil	nil	0.02
Lead	nil	nil	nil
Silver	nil	nil	nil
Iron	traces	traces	traces
Aluminium	traces	nil	nil
Oxygen, &c.	0.17	0.21	0.10
	100.00	100.00	100.00

Arsenic is, of course, a deoxidizer in copper, as is well shown by the analysis of brand 3, but its presence in abnormal quantity seems to cause the separation of very large quantities of eutectic, leading to the production of a very poor gunmetal. My opinion is, that although most of it goes off in the melt, the amount that is left seems to have some directive action upon the distribution of the tin, causing the separation of more eutectic.
The casting temperature of gunmetal does not seem to make much difference in the structure. To determine casting temperatures, we use the pyrometer to some extent. It is, of course, unnecessary to use it with every melt, because a good furnaceman can gauge accurately enough the temperature he usually pours at. But he would not know what that temperature was without actually determining it, and it is useful to know it, so that a comparison may be made with the work of other founders. With us, the usual temperature to which the metal is raised, before pouring into the shank ladle, is, in the case of the tilting furnaces, about 1,250 deg. C., as deter-

mined by the Foster pyrometer. After pouring, the metal in the ladle is at 1,200 deg. C., and this is about the usual temperature for pouring into the mold. It, of course, cools a little more in the interval before pouring.

To test the effect of casting at different temperatures, two test pieces were cast in sand at four different temperatures, 1,200, 1,150, 1,100 and 1,050 deg. C., these being the temperatures of the metal in the ladle before pouring into the mold. On turning up and breaking the test pieces, the following results were obtained:—

	Gasting temperature	Yield point	Ultimate Br. strain	Elongation
	Degrees C.	Tons per square inch.	Tons per square inch.	Per cent
1 ..	1,200	11.3	17.8	18
2 ..	1,200	10.9	18.1	20
3 ..	1,150	12.4	18.6	17
4 ..	1,150	12.2	18.0	20
5 ..	1,100	11.6	18.3	16.5
6 ..	1,100	11.0	19.1	22
7 ..	1,050	12.4	18.2	16
8 ..	1,050	11.9	16.6	10

There is little difference in the results, except that as regards elongation those cast at the higher temperatures, 1,200 deg., are somewhat better. The only decidedly poorer one is the last of the two poured at the lowest temperature, when the metal was getting very pasty and on the point of beginning to solidify. The micro-structures were all much the same. I believe it is the general opinion that the casting temperature makes a good deal of difference in the structure and strength of the metal, but the only possible opinion one can hold is that which has been tested by oneself.

In the case of a larger melt, of about 3 tons of metal, in the air furnace, during tapping to cast a 28-in. pump, the following temperatures were obtained:

	Deg. C.
Temperature of metal in furnace before tapping	1,350
Temperature of metal in ladle after tapping	1,300
Temperature of metal in ladle before pouring	1,200

These are about normal temperatures for this furnace, and they show that the metal before pouring has attained about the same temperature as in dealing with small quantities in the tilting furnaces. The results from the test piece cast on to the 28-in. pump above-mentioned, were as follows:—

Yield point	11.0 tons per sq. in.
Ultimate breaking strain	16.4 tons per sq. in.
Elongation	14.5 per cent.

The brands of copper, tin and spelter used were the same as in the other experiments just described, which were made at practically the same time. Results obtained from a cast-on test piece are always lower than those from one cast separately.

There are some other defects that may be met with in gunmetal, and have not yet been mentioned. These are so infrequent as to be almost negligible as sources of trouble. They may be briefly described as follows:—

Blowholes, caused by the escape of steam or other gases from the mold, under such conditions that they are not carried away, but remain in the solidifying metal. These cavities are generally near to the surface of the casting, and as the gases, on passing from the mold into the metal, exercise a pronounced chilling upon the molten metal with which they are in contact, the holes can be recognized by the difference in structure of the metal surrounding them, this being the same as is obtained in chill casting.

Gas Holes are caused by the liberation of gases dissolved in the molten metal and may occur in any part of the casting. The metal forming the boundaries of these holes naturally does not show the chill structure characteristics of the blowholes, and the difference between the two is thus readily distinguishable.

Inclusions of Copper Oxide are caused by oxidation in melting. Copper oxide being a hard and brittle compound, causes weakness. As a matter of fact, the production of copper oxide is almost entirely obviated by the presence of the 2 per cent. of zinc added to the gunmetal. Zinc being a very oxidizable metal, combines with any oxygen that may be present, either combined with any of the other metals present, or existing in the free state dissolved in the molten mass, with the result that the metal is more fluid or “runs thinner,” as it is described.

There is one thing that is worth mentioning before leaving the consideration of gunmetal, and that is that by annealing at a temperature of about 700 deg. C. for quite a short time, about half an hour, it is possible to decompose all the eutectic, replacing it by solid solution of tin in copper, and thereby materially increasing the tensile strength and elongation of the metal. There are, of course, practical difficulties and some risk of injury in annealing castings, especially those of any size, under such conditions, but the point is obviously of some practical importance.

FROM AMBER TO DYNAMO.

PART III. SOLUTIONS AND ELECTROLYSIS.

BY H. E. WILLMORE, Jr., B. S.

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In the preceding articles of this series, the author deals with static electricity and the relation between static and current electricity. Mr. Willmore is handling his subject in a clear manner and is eliminating all useless and irrelevant text-book matter so that our readers may obtain clearest comprehension of the subject under consideration. In this article an explanation is given of the relation of conduction by liquid conductors to conduction by solids and some of the chief characteristics of electrolytes are pointed out. Succeeding articles will deal with units of electrical potential, current and power; the best types of batteries for use in plating; electrical circuits; magnetic circuits; measuring instruments; dynamos; dynamo troubles and design of plating room.

The theory of the propagation of an electric current through solid conductors has been briefly outlined in Part 2. It was there explained that the passage of an electric charge through a solid conductor was due to the transfer of electrons from molecule to molecule along the path of the current. The molecules in this case act as a sort of bucket brigade handling electrons from one to another. No mention has been made of the way electric charges are transmitted through liquid conductors. Liquid conductors are of prime importance to the electroplater for two reasons: (1) because they constitute the media by which metal is transferred from the anode to the cathode in the plating solution and (2) because they furnish the plater with one very important means of obtaining a constant difference of potential, which was shown to be necessary for the maintenance of an electric current through any conductor.

Consider Fig. 9. Suppose A and B to be carbon or platinum conductors sealed into the sides of a glass vessel which is to be filled with a liquid C. Suppose also that a difference of potential exists between A and B. If turpentine, olive oil, petroleum, alcohol or a number of other such liquids are used for C, no appreciable current of electricity will pass between the electrodes A and B. The liquids are insulators similar to the solid insulators which, as was previously explained, are thought to have their electrons in some way bound to the atoms. If, on the other hand, mercury is used for the liquid C, a current will flow exactly the same as through a solid conductor such as a

copper wire. Molten metals when tested with the proper apparatus are found to be conductors similar to mercury.

If distilled water is placed in the vessel of Fig. 9, the amount of electrical charge which will flow between A and B in any given time will be found to be very small. If pure hydrochloric acid, sulphuric acid, sodium hydroxide or any number of other acids and bases are placed in the vessel the result will be about the same as for pure water. Tests with pure chemical salts such as common salt, copper

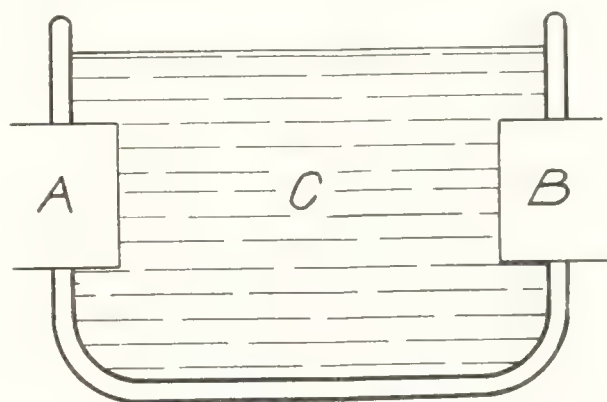


FIG. 9

sulphate, potassium nitrate and the like, will show that these salts are very poor conductors in the dry state and as far as the plater is concerned may be classed as insulators. But if a little common salt is dissolved in the distilled water and this solution is tested in our apparatus of Fig. 9, the result is remarkably different. The quantity of electric charge flowing through this solution in a given time is many times as great as it is for pure water

or dry salt with the same difference of potential between A and B. This solution is an excellent conductor. A chemical action accompanies the passage of a current through the solution as is evidenced by the bubbles of gas which arise from the electrodes A and B. All such liquid conductors in which the passage of a current is accompanied by a chemical change are known as electrolytes.

Hittorf found that the chemicals whose aqueous solutions were good conductors, belong to the three classes—acids, bases and salts. One of the chief characteristics of all acids, bases and salts is that each is composed of two distinct parts, one of which is decidedly metallic in the nature and the other non metallic. The metallic part is not limited to what are ordinarily known as metals, but includes such elements as hydrogen, carbon and calcium, and a few important groups of elements (called radicles) such as ammonium (NH_4). The non-metallic portion of acids, bases and salts may consist of elements,—as chlorine or oxygen,—but more often of groups of elements such as the nitrate radicle (NO_3), the cyanogen radicle (CN) and the sulphate group (SO_4). An acid is composed of hydrogen and a non-metallic element or radicle; and a base is made up of the hydroxyl radicle (OH) and a metal or metal-like radicle. When an acid reacts with a base, the hydrogen of the acid (the metallic part) combines with the hydroxyl of the base (the non-metallic part of the base) to form water, while the remaining part of the acid and of the base form a salt which is, therefore, composed of a metallic part from the base and a non-metallic part from the acid.

Much can be learned from the chronological developments leading to the present theory concerning the conductivity of electrolytes. Fig. 10 illustrates the theory of Grotthus. The solution represented by this figure is common salt solution, although the scheme may be applied to any solution of a salt, acid or base. The asterisks represent the metallic part and the circles the non-metallic part of which the salt is composed. Stage *a* of Fig. 10 represents the molecules of salt between the unchanged electrodes. The asterisks, therefore, represent the atoms of sodium and the circles the atoms of chlorine. They are proportioned according to the composition of salt:—one atom of sodium to one atom of chlorine. "Stages *b*, *c* and *d*" illustrate the action which takes place immediately after the electrodes

are charged according to Grotthus' explanation of electrolytic conductivity. In the neutral state of the solution the metallic sodium atom is associated with the positive charge of the molecule, while the non-metallic chlorine atom carries the negative charge of the molecule which is exactly equal to the positive charge. (To state this according to the electron theory we would say that the non-metallic atom carried the greater number of electrons.) Now Grotthus' explanation states that the force of attraction between the positive or higher potential electrode and the negatively charged chlorine atoms, and between the negative or

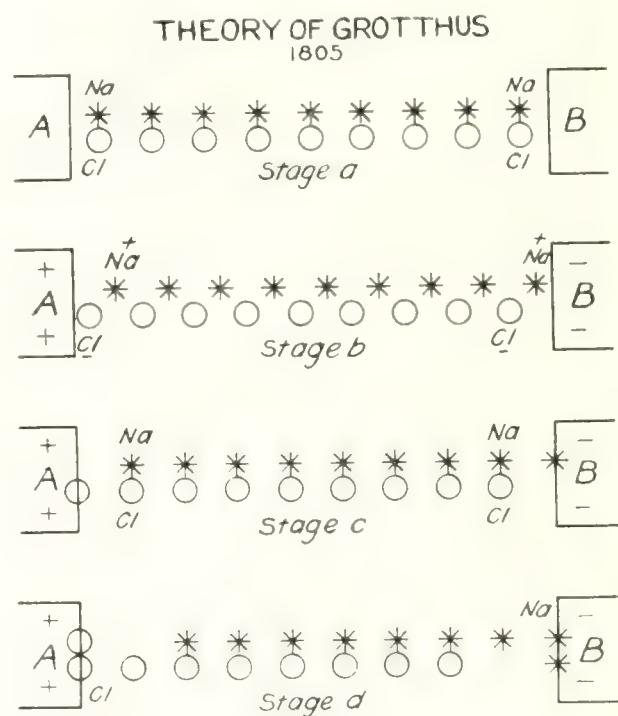


FIG. 10.

lower potential electrode and the positively charged sodium atoms by overcoming the force of attraction between the different atoms, tends to tear the molecules of salt into their constituent parts, causing an exchange of partners and a general migration of the metallic atoms (Na) toward the lower potential electrode and of the non-metallic atoms (Cl) toward the higher potential electrode. Sodium atoms, therefore, appear at the negative electrode and chlorine atoms at the positive electrode, while in between the electrodes there remains unchanged salt solution.

The thing which impressed Grotthus and those who followed him is the fact that the products of electrolysis appear at the electrodes the instant a difference of potential exists between them and continue to appear as

long as this difference of potential exists, or until the electrolyte is exhausted. From this it is obvious that the carriers of electricity move. Faraday gave the name *ion* to the carrier. In order to distinguish between the metallic and the non-metallic charge-laden atoms or radicles, he called the positively charged metallic ions *cat-ions* because they move toward the lower potential electrode or *cathode*; and he named the negatively charged non-metallic ions *an-ions*, because they moved toward the *anode* (the higher or positive potential electrode).

The theory of Grotthus does not entirely explain the phenomena of the conductivity of electrolytes, because no definite force or difference of potential is required to start a charge flowing through the electrolyte. From his theory we would expect that no action would take place until the potential between the electrodes was sufficiently great to overcome the force of attraction between the unlike components of the molecules. Clausius in about the middle of the nineteenth century (fifty years after Grotthus had expounded his theory) raised the above objection, pointing out that with inactive electrodes the quantity of electricity passing through an electrolyte in a given time is directly proportional to the difference of potential existing between the electrodes. His explanation of the facts stated that some of the molecules of the dissolved substance while moving about and striking against other molecules were split into their charge-carrying atoms. These ions in wandering about the solution often came into contact and united with atoms of the opposite kind, but at all times a certain proportion of these molecules were split up. It is upon these resultant ions that the charged electrodes act, giving them direction of motion.

In 1887 Arrhenius propounded his *ionization theory* or the *theory of electrolytic dissociation* as it is sometimes called, which today offers the best explanation of the various properties of solutions inclusive of conductance that has as yet been presented. According to this hypothesis the dissolving of a salt, acid or base in water is accompanied by a splitting up of a part of the molecules of the dissolved substance into metallic and non-metallic charge-laden parts. The remarkable feature of Arrhenius' theory is the excellent quantitative results to which it leads. According to Arrhenius a solution which conducts electricity

readily has a large proportion of the dissolved molecules split up into anions and cations, while a poorly conducting solution contains few anions or cations. He, therefore, attributes the conducting property of electrolytes only to that portion of the dissolved substance which has been ionized. The ions move through the solution, carrying their charges to the electrodes. From this we see that the amount of electricity which will be conducted through an electrolyte in a given time depends on (1) the number of ions in the solution or the extent of ionization and (2) the speed of the ions through that solution.

Anything which affects either the dissociation of a substance into its ions or the speed of these ions affects the conductivity of the electrolyte. These things are many and their effects so varied that it is impossible to give them anything like an exhaustive treatment here. Moreover, years of study and research work will have to be done and volumes of data compiled before we can lay any claim to a comprehensive knowledge of the behavior of specific electrolytes. It is possible, however, to point out a number of general causes and effects, a knowledge of which may help to explain some of the apparently contradictory statements of different workers in the plating industry.

First of all, the plating solution is in its simplest form an electrolyte, which while being exhausted of its metallic ions at the cathode is forming new molecules and ions at the anode by chemical action. If we investigate the electrolysis of a blue vitriol solution between copper electrodes we shall find the positively charged copper ions discharging upon the cathode and the sulphate ions traveling to the anode. These sulphate radicles when delivered of their charges are chemically very active and attack the copper anode, producing a fresh supply of copper sulphate molecules ready for ionization. Theoretically then, the copper lost to solution as a whole has been replaced. Kohlrausch showed that the ions of various elements and radicles move with different speeds, causing an increase of concentration around one of the electrodes and a decrease around the other. In the case of copper sulphate solution, the sulphate ions move faster than the copper ions and the solution gradually increases in concentration around the anode. Upon standing idle, the solution diffuses. The effect does not usually become accumulative in

plating solutions, because the solutions are stirred more or less by placing work in and taking it out, and because in some solutions the gases given off serve a useful purpose of keeping the electrolyte in motion.

Concentration of a solution affects its electrical properties in two ways: (1) in very concentrated solutions, the viscosity decreases the speed of the ions and (2) concentration decreases the *proportion* of molecules which are split up into ions. The second is the more important to the plater. Since it is the water which causes the ionization, we would naturally suppose that the greater the proportion of water the greater would be the proportion of molecules split up. This is the case, and interpreted means that for a given amount of salt, acid or base the number of ions depends upon the amount of water in which it is dissolved. Too much emphasis cannot be placed upon the fact that twice as much of a salt, acid or base with the same amount of water may have almost twice as many ions, although the percentage of ions to molecules will be less. In other words, if we place pure water in the vessel of Fig. 9 and maintain a constant difference of potential between the electrodes, we will find that by adding a grain of common salt at a time, the more salt we add the greater will be the electrical action up to the point of saturation of the solution. The charge carried from electrode A to electrode B will increase, but the proportion of salt ionized, and therefore useful,—will decrease at the same time. Exaggerating the condition, we have the following:—the first hundred grains of salt added all ionize and become carriers of electricity; out of the second hundred only ninety ionize; out of the third hundred only eighty-four dissociate, etc.

The temperature of an electrolyte affects its conductivity by changing the speed of the ions. In general, an increase in temperature augments the electrical carrying property of a solution by increasing the speed of the ions, much the same as we would expect an increase of voltage to do. This is, of course, independent of such purely physical or chemical characteristics as raising the point of saturation.

(To be continued.)

Most of the present methods of rust proofing iron and steel consist in converting the surface of the article treated to black oxide of iron or phosphate of iron.

PHILADELPHIA ELECTRO-PLATERS' GATHERING.

The Philadelphia branch of the A. E. S. held its most successful open meeting on Jan. 15 at the Hotel Windsor. In addition to practically the entire membership, about forty visitors were present.

Joseph L. Dinan, president of the branch, first called on C. H. Proctor, who spoke on the development of the Society. He was followed by Walter C. Gold with a paper on "Generalities regarding the A. E. S", emphasizing the need for true economy. G. H. Niemeyer spoke on "Anodes", particularly dwelling on the necessity of securing the purest materials.

"Standardization for the Plating Department" was the title of a paper by Dr. Max Weber, New York, read by C. Dittmar. This also dealt with the need for purest materials in plating baths, and advocated the use of standardized salts, such as the new metal cyanides, which the plater can depend upon to always run the same in metal and other chemical contents.

S. D. Benoliel gave an address on "Cleaners", showing how the best methods to employ depend largely on what the subsequent operations are to be, whether japanning, lacquering, plating, etc. The plater must see that proper materials are used for cleaning, as so many of his own troubles are due to improper cleaning.

L. E. Sturtevant gave an interesting talk on lacquers, and mentioned the importance of securing a non-acid lacquer.

Luncheon followed the meeting, and social intercourse resulted in the placing of several application forms for membership in the hands of the secretary.

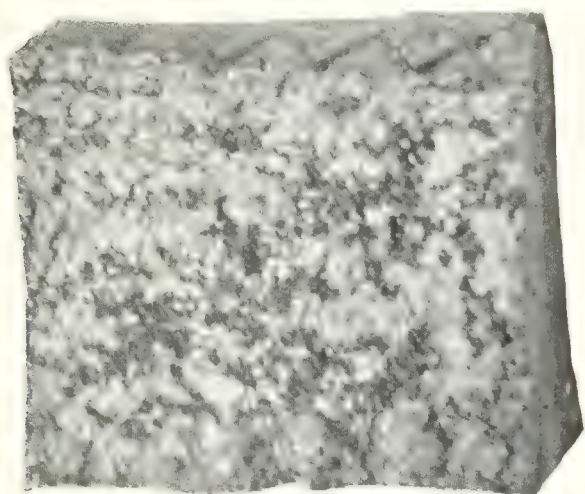
R. F. Lang, 8-10 Bridge St., New York, known in the trade as the pioneer in the introduction of "Phosphor Copper" in the States, announces that he is now again in a position to fill orders on all the "Royal" products, including "Royal" High Power Rapid Nickel Salts of the same high quality as previous to the outbreak of the European War. Mr. Lang reports that prospects for 1915 business are good. They should be to him, for he is never one to sit down and wait for business. He hustles after it and hustling always brings results.

INSIDE, OUTSIDE, OXIDE!

BY R. R. CLARKE.

Continued from Page 11, January 1915.

The exclusion of the air must be accomplished through surface protection. This protection can be in the nature of a substantial flux, or powdered glass, dry sand, pulverized charcoal or in fact any air-excluding substance. Of all those to be recommended we are unreservedly in favor of charcoal finely crushed. For this we might advance many reasons, but



Section of Oxidized Metal, (Copper, Tin, High Lead.)

will deem the logic of our opinion fairly well established by statements of the simple facts that it forms a good protective body, is strong at high temperatures as both a reducing and combining agent and insures the metallic surface against injurious gases arising from fuel combustion. By a reducing agent, we refer to any substance endowed with the power to abstract oxygen. Being a porous carbon, charcoal has the power not only to combine with oxygen and thus keep it away from the metallic surface but also to abstract oxygen from oxides therein. So pronounced is this latter tendency that copper oxide, mixed with powdered charcoal in a tube and heated, gives off carbon dioxide and leaves copper behind.

Along with prevention arises also the consideration of furnace type, fuel, etc. We are sorry that the nature of this discussion, of necessity, calls forth a statement detrimental to the principle involved in certain types of melting devices. Out of consideration to the manufacturer we would much rather suppress this opinion. However, we are dealing with

principles and cannot avoid making the statement that any non-ferrous metal-melting furnace admitting or forcing an oxidizing flame directly on the metallic mass, supports the oxidization of that mass and cannot be judiciously used. As to fuel, good, 72-hour foundry selected coke, low in sulphur, is the logical selection. Coke and charcoal are forms of the same kind of carbon and in many particulars what has been written in favor of charcoal will apply to coke also.

As to the type of furnace we believe, that of those of general and accepted worth, the natural draft, pit-type crucible furnace produces the minimum of oxidation. The efficiency of this type is raised or lowered by principles in construction. It should be amply spacious to avoid crowding the crucible and of sufficient depth to allow the top of the crucible, in melting position, to rest at least six inches below



Section of Metal Free from Oxide.
(Copper, Tin, High Lead.)

the egress draft conduit. This allows the gases and flame arising from fuel combustion to rise and pass over the metal surface without "skimming" it, at the same time creating a partial surface vacuum in the vicinity of the metallic surface. Of the true status of the electric furnace we are not certain. What advantages it may have to offer is to us problematical. Certain it is that, unless hampered

by manipulating limitations, the nature and development of electric heat is such as to offer possibilities in decided harmony with the best principles of non-ferrous metal melting.

But prevention, however scrupulously observed, is still inadequate to cope with the oxide evil in full. We cannot exclude all the air and the occurrence of more or less oxide is an absolute certainty so long as air in any measure is present.

Campaigning against those oxides that develop in spite of preventative effort, constitutes the subject matter of elimination.

Elimination.

Elimination consists in introducing some element, through the influence of which the oxygen of the oxide will desert its metallic associate, combine with the added element and pass off in a resultant gaseous compound. Such an agent is referred to as a deoxidizing agent and, from the nature of its service as such, must possess a strong affinity for oxygen. Those most common to the brass and bronze alloy are: Phosphorus, manganese, zinc, magnesium, silicon and charcoal. Of these phosphorus is perhaps the most efficient, combining with oxygen in the ratio two parts phosphorus and five parts oxygen (P_2O_5). Its use, however, is limited. In the presence of zinc or excess lead it is of greater detriment than benefit. In most cases a 1 per cent phosphor constituency will be found efficient. Manganese is seldom used for the direct purpose of deoxidizing. When used for other purposes its deoxidizing tendencies become apparent. The same can be said of zinc. The highest oxide of manganese contains 2 parts manganese, 7 parts oxygen (Mn_2O_7). Zinc oxide is half and half zinc and oxygen, (ZnO). Care must be used in the use of magnesium, this element being superinductive to brittleness. For this reason its quantitative figure should not exceed one half of one per cent. It combines with oxygen in the ratio 1 to 1, (MgO).

Charcoal and silicon are surface affairs. The former has already been discussed. Silicon improves the casting nature of copper and deoxidizes. It combines with oxygen two parts oxygen, 1 part silicon, forming the dioxide SiO_2 . So much for elimination. It is a means toward an end though never entirely to that end. Isolation alone remains.

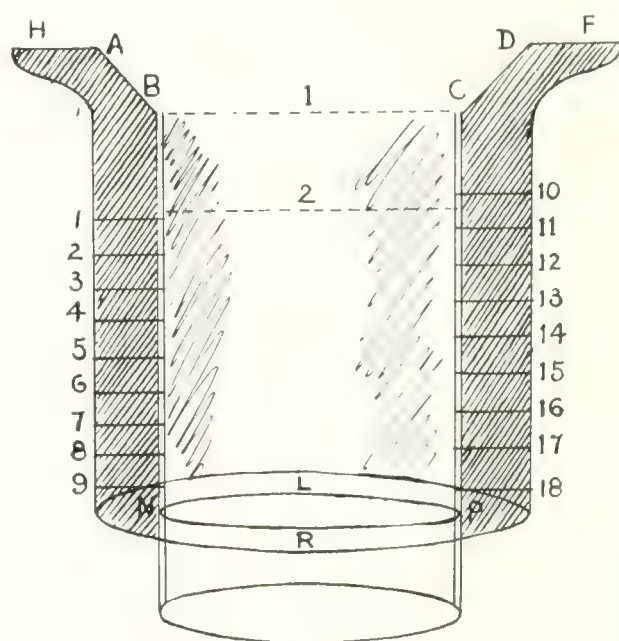
Isolation.

This consists in driving the oxides to that part of the casting where they will do least

damage. The difference in specific gravity between the metal and its oxide is responsible for this advantage. Usually the oxide is the lighter and will seek the molten metallic surface. In metal only partially oxidized, however, this will not always be found the case.

The more liquid the mass, the greater the ease with which the oxide will seek and maintain surface position. Consequently, strong and well-fortified molds indicate better judgment in foundry practice than the pouring of cold and sluggish metal. Nearly all castings have vicinities of varying particularity. That of least importance should determine the location of isolation and consequently be accorded the highest point in molding position to which much of the oxide will naturally rise. This may often entail increased molding expense yet, for all that, its logic cannot be questioned. In addition to this, "bosses", skim gates, extra finish and various means of mechanical nature can be employed.

The illustration represents a pipe end with a valve seat. The easier way to cast would be to part at dotted line No. 1 and accord H F the cope position in the mold; but the surface indicated by A B —C D, constitutes the valve seat and should be clean, perfect metal. Cast-



ing from dotted line No. 2 to the bottom N L R P is not so particular, being largely to accommodate the rivets indicated by 1, 2, 3—10, 11, 12, etc. Consequently the surface N L R P should constitute the locality of isolation and be accorded the top or cope position in casting. All this entails extra casting difficulties, but

these should not be permitted to stand in the way especially if the valve operates against great fluid pressure.

In further consideration of prevention and elimination of oxides, a practice of sterling worth, though of much inconvenience, is to cover the metal in the sprue with pulverized charcoal immediately after pouring and allow it to cool under this as both a protective and reducing agent.

We might go on indefinitely. There seems to be no limit to which the argument will carry, but we have borne it already to the limits of reasonable space. Abbreviation has compelled us to pass unnoticed by the wayside, many worthy considerations. However, we have aimed to cover the more important and will close by submitting a few scattered illustrations picked up along the route of our wanderings.

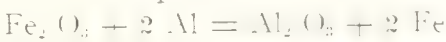
THE ALUMINO-THERMIC PROCESS: ITS METALS AND ALLOYS.*

The word "Thermit" is derived from the Greek, "thermos" meaning "heat", from which we have many derivatives, such as thermometer, thermo-couple, etc.

In 1894-95 Dr. Hans Goldschmidt succeeded in reducing the oxides of various metals by means of granulated or finely divided aluminum. This success was obtained after two years or more of experimenting with various mixtures, with but unsatisfactory results,—either no reaction took place, or there was not sufficient heat to start the operation, or a violent explosion resulted.

Dr. Goldschmidt found, however, that intimate mixtures of metallic oxides and powdered aluminum, if heated strongly at one point, reacted with the production of intense heat, the temperature produced being far greater than that required to initiate the reaction. Consequently, the reaction spread throughout the entire mass very rapidly, the time absorbed being about 30 seconds in the case of the iron oxide and aluminum, not appreciably depending on the quantity of material used.

The reaction, from the chemical standpoint, is one of the simplest—



*Published by courtesy of A. F. Braid and Alfred Beaulieu, Chicago.

and similar equations can be written to represent the reactions in the case of other metallic oxides. The temperature from this reaction is about 5400 deg. F., which is considerably in excess of that necessary to fuse aluminum and iron, which are the resultant products.

By using other metallic oxides in place of iron oxide, Dr. Goldschmidt was able to prepare many other metals and alloys in a fused, or molten condition. He also found it was possible to reduce the sulphides of various metals in a similar manner, and in one case a non-metallic oxide—boron trioxide.

Of the various uses to which thermit is adapted, the principal one is the welding of steel, wrought iron, and cast iron.

As the welding of the first two of these is so well known and has been used all over the world with great success, in past years the welding of cast iron has been discouraged to a considerable extent, owing to the uncertainty of results. This was due to the difficulty in allowing for shrinkage stresses resulting from the cooling of the metal in the weld and which tended to start a crack, either in the weld or in some point in the immediate vicinity, when the weld began to cool.

In previous years manganese was introduced into the welding portion for cast iron, but results were not of the best; on further experimenting an ideal mixture has been attained. Into the thermit is introduced 20 per cent of mild steel punchings, and 3 per cent of 50 per cent ferro-silicon. This gives a soft and homogeneous metal in the weld, and one which is easily machined. It is safe to say that if this welding portion be used in cast-iron repairs, and if the fracture to be welded is in such a position that the metal is free to expand and contract, no difficulty will be experienced in obtaining satisfactory results.

The only case where cast-iron should not be welded with thermit is where the metal is not free to expand and contract, with the result that shrinkage stresses are invariably set up, with which it is difficult to cope.

(To be continued.)

Molybdenite, used in the manufacture of molybdenum steel, has recently been discovered in Tasmania. This rare mineral, worth at present about \$2,500 per ton, has the property of increasing the hardness and toughness of steel.

TREATMENT OF STOVE CASTINGS PREPARATORY TO PLATING.

By HARRY E. STARRETT.*

There has been a wonderful progress during the past 25 years in the art of electroplating, and probably this progress is no more evident than in the special field of plating stove-trimmings. This is due to the fact that not only has the science of chemistry advanced wonderfully during that space of time, but much of the work which was formerly done by hand is now done by machine and can therefore be subjected to much more definite and, therefore, more accurate rules or standards.

Statements will no doubt be made in this article and others, with which some readers may not agree, and to this there is no objection whatever. It should, however, be understood that these articles must of necessity be somewhat general in character, and that such statements as are made are drawn from general practice covering many different plants and conditions. There may be exceptional instances which the statements may not seem to fit, but no doubt readers will make allowances for such cases. It is not the intention to pre-judge important questions upon which there may be divided opinions, and the final decision will, of course, rest with the practical man, who by actual experience has demonstrated whether one way or the other—or possibly both ways—is the more desirable way of doing a certain job under certain circumstances.

In our investigation of the methods employed in the treatment of stove castings before plating, we have found a great variety of methods in use and it is particularly noticeable that the stove companies in the West employ methods quite different from the older companies in the East. It is a question whether the newer methods of the Western companies are better than the processes of the East, although it can be assumed that they are, for the reason that they are more uniformly observed by the various companies, whereas in the Eastern part of the country very few shops use identical methods. One important fact must not be overlooked and it is this fact which in a measure accounts for different methods, the

character of the castings which are furnished by the foundry. We believe that in the past too much attention has been paid to the castings after they reach the polishers' hands and not sufficient caution and criticism given to the foundry end. We have invariably found that improvements were more necessary in the foundry end than in the polishing and that the inability to turn out good plating is due chiefly to the character of casting delivered to the polisher. To deal intelligently with the subject it is necessary to begin with the casting

Pattern-Making and Molding.

The pattern maker should be familiar with the shape and design that will best take the polish and the plate and have this point in view as much as he anticipates the molding necessities. The molder should have in mind the necessity of a smooth surface and use of the facing best adapted to leave the background clean and smooth, and the furnace man should provide a formula for the mixture that will produce high silicon so proportioned that a close grained soft casting can be obtained. Care should be taken in pouring the metal; the mixture may be all right, but an entire heat may be spoiled by the iron being too hot, thus burning the sand in the background; the sand can be too wet and chill the surface of the casting, necessitating extra pickling which ultimately results in sweating out through the plating, causing rust spots.

Tumbling.

In some instances dry tumblers are used with jacks, the dust exhausted by a blower keeping the castings clean. Of late water tumblers have been introduced with good results. If the castings have received the proper attention in the foundry and by the pattern-maker and molder, the advanced method of tumbling will prepare the casting so that no pickling or scratch-brushing is necessary before the work goes to the polisher.

The use of the sand blast is to be recommended. When the sand blast is used very hard castings can be treated and prepared for the polishing operation without the necessity of pickling.

*Western Sales Manager of Hanson & Van Winkle Co., Newark, N. J.

In some shops it is often necessary to pickle the work in order to soften the surface of the iron so that it can be readily polished. While we have outlined the character of casting preferred, the large problem for the foundryman is to keep down the percentage of breakage in producing soft castings. For this reason the foundryman will go the permissible limit in close-grained castings, but these castings seldom run soft enough to polish without extra labor, unless pickled. There is perhaps no process which is more thoroughly discussed and experimented with than pickling, and it is generally conceded hydrofluoric acid can be used with the least danger. It is however known that while hydrofluoric acid will remove sand and clean surfaces properly, it will not soften the iron quickly and that the use of a mixture of sulphuric and hydrofluoric acids gives better results. There is a diversified opinion as to what can be used as a standard solution. This division of opinion is caused by the different mixtures used by the different companies. We believe a solution composed of:

Hydrofluoric acid	2 parts
Sulphuric acid	1 part
Water	8-10 parts

will cause the least danger to the work, if not left in the pickle too long. If castings are too hard it is necessary to use less water in order that the acid may work more quickly. Sometimes a little heat, say 140 to 160 deg. F., can be used, to expedite the working of the pickle. It is always best to use the pickle as weak as will give desired results in a limited time.

A pickle that will not properly treat the castings in two or three hours' time should be looked upon as dangerous to use. If the pickle fails to produce results in the above period it would be well to direct attention to the foundry and tumbling room and see that necessary improvements are made to aid the pickle to do its part without detrimental results.

Polishing.

No line of polishing differs more widely in manner of operation than the finishing of stove trimmings for plating. The reasons are as follows:

We have already outlined the different methods employed in stove castings on account of the character of castings and method of making. The difference is small in the foundry. It does not increase very much by

change of pickling methods. However, when the castings reach the polishers there is another division of operation which is followed to produce the different grades of finishes required, which if fully described would make an endless story. It will be therefore necessary to treat this subject in a general way and indicate a composite line of directions in which a general method of polishing can be outlined.

Stove manufacturers, doing their own plating, turn out many classes of work. Some companies manufacture a great many base burners; these are mounted with the highest grade of nickel trimming which can be produced. Some companies make a line of high-grade ranges on which the trimmings are also finely finished. Other companies make a line but do not aim to reach this high grade of finish. The third class of manufacturers confine themselves to a cheap line where the expense on the finish is reduced as much as possible, consistent with the sale of the goods. We will therefore divide the operation into three classes, calling the high-grade work a "five-wheel operation", the medium grade of work a "four-wheel operation" and the cheaper grade of work a "three-wheel operation."

(To be continued.)

"CUPROR" ATTRACTING INTEREST.

"Cupror" is classed by its discoverer as a bronze. It is the result of years of continual seeking and experimentation of L. C. Smith, president of the L. C. Smith Co. of Bridgeport, Conn. Mr. Smith has been accused of following the will-o'-the-wisp of the medieval alchemists—the possibility of transmuting the baser metals into gold. In view of the many wonderful things that have been accomplished by scientists during the past 50 years, it would not be prudent for us to absolutely declare that the alchemists dreamed vainly. It is quite certain, however, that L. C. Smith has got nearer to his aim than Paracelsus ever did. He has produced a metallic composition with a wide range of properties and possible uses and which can be furnished in perfect imitation of any shade of gold from 12 karat to 24 karat. Copper is the main ingredient of "Cupror" and Mr. Smith claims that the secret of its production does not lie so much in the metals used to make the alloy as in the

chemical treatment give to it. The articles manufactured from "Cupror" are known as "Durigold."

Mr. Smith has been engaged in varied industries in Chicago and New York during the past 33 years and has traveled extensively abroad. About three years ago he came to Bridgeport to engage in the final work of "Cupror" production and established a foundry, and during the past two years he has attained his object. He has produced a metal of sufficient merit to engage the attention of the United States Government which has been considering the advisability of using it for the manufacture of our penny coinage.

jects which are at present being made from this new metal. One of the most interesting uses to which it is being put is the manufacture of pipe for the conducting of acid and acid wastes. Boat fittings, harness trimmings, coffin trimmings, dental and surgical instruments, mesh bags, table cutlery, plumbers' goods, uniform buttons, steam goods—these represent some of the varied uses of the new metal. The L. C. Smith Co. has a strong selling organization in New York which is aggressively marketing the "Durigold" products as souvenirs for the Panama-Pacific Exposition. The souvenir coins for the commercial Ter-Centenary of New York last year were



A Christmas Display of Articles Made From "Cupror."

The working qualities of "Cupror" seem to be without limitations. It can be rolled into sheets as thin as wished up to 36 gauge. It can be worked into wire of one thousand and seven tenths fineness. It can be extruded into rods and bars with ease. The published test results on the metal are: tensile strength of the wire made from it, 140,000 lb. per sq. in., the strength of "Cupror" castings, from 87,000 lb. to 98,000 lb. per sq. in.

Many tests have been made on it to ascertain its resistance to acid attack. Immersion in C. P. nitric acid and a solution composed of nitric acid, hydrochloric acid and sulphuric acid shows no evidence of attack on the submerged pieces, which retain their color without any sign of deterioration.

The illustration shows some of the many ob-

jects made the size of a twenty-dollar gold piece of "Cupror" and uplicated the gold coin in color to perfection.

Special information concerning the application of "Cupror" to any trade use in which our readers are interested can be obtained by application to the L. C. Smith Co.

A new company has been formed in England, under the name of High-Speed Alloys, Ltd., 13 East Parade, Sheffield, with a capital of almost \$250,000, to produce metallic tungsten, used in the manufacture of high-speed and armament steels. Since the commencement of the war, the supply from Germany has been cut off, and the price of the metal has risen from about 57 cents to \$1.22 per lb.

POOR PLATER!

BY ONE OF THEM.

Barrel or mechanical plating is one of the latest results of the application of brains to the rapid production of small plated articles, and, like all other plating methods, it has numerous variations in practice. Some of these are comprised in the construction of the barrel and the rotating device, others in the make and design of the anode and in the different solutions. To try to instruct or advise the plater without knowing the output of his dynamo in volts and dynamos is out of the question.

Three factors are to be considered in plating: firstly, the dynamo, secondly, the solution, thirdly, the anodes. Dynamos are of different voltage and amperage; solutions are of various composition; anodes also vary.

The object of the anode in any solution is to dissolve easily, and my own experience along these lines has led me to believe that the best and cheapest anode for a brass or copper solution is wire, every wire in itself being an anode. The old scrap plating wire ends when pounded, or the coils of press room metal from which blanks have been cut, after bright dipping and pounding, make perfect anodes. In this manner I have saved in cyanide alone, in five barrel brass solutions, one 100-lb. case in three weeks, besides obtaining a more uniform yellow brass color, every day alike. I have no newly-patented salts or devices to sell, but only a little advice to give freely to platers.

For example, a small plating room, with eight or ten nickel or other solutions, is using all the amperage that the dynamo can supply. A newly-patented solution is introduced which requires twice as many amperes. The dynamo cannot supply this, and the plater is in trouble. If the salesman had only thought of this, the difficulty would have been avoided.

Again, think of the thousands of plating rooms in the country, no two alike. I shall describe two types that I know well. The first is clean and nearly as sanitary as it can be made, with plenty of windows for the admission of good daylight, clean running water, good cleaning solution, well warmed. It has the latest improved dynamos, rheostats, voltmeters, ammeters, drying bins and ovens, racks and wire, plenty of chemicals, tons of anodes of all kinds, blowers to remove foul

air and fumes, in fact everything necessary to do good work. The second room is dirty and foul smelling, and never had daylight. Iron gaspipe carries the current from old second-hand dynamos to the tanks, and there are no rheostats, voltmeters or ammeters; chemicals are bought just as you use them; there is one cold water tank for going in and out of brass, copper and nickel solutions, potash and cyanide, acid dips and pickles.

With all these disadvantages, the article plated in this latter room is expected to be as good in color and finish as in the first. The goods are plated in a dark room, but are taken to the brightest light for inspection.

Then again, when improvements are finally decided upon, the superintendent will often take the matter into his own hands entirely, without consulting the plater. All he gets is the blame when things go wrong. Make a wooden tank for a silver solution and put white lead in the joints. When the cyanide takes up the lead and all the silver is black or dark brown, blame the plater!

Line a tank with sheet lead for a hot cyanide copper. The anodes will become coated with lead, and no amount of cyanide will remove it, nor acid dip; it must be scoured. Blame the plater!

Line it with pitch and the hot solution will run it all to the bottom. Blame the plater!

Put an acid copper solution in an iron tank and spoil the solution. Use a galvanizing solution in a tank for a year or so, then put in a nickel solution, turning it black. Blame the plater!

Then we have similar trouble with the subordinate help. I have seen nickel solutions boiled up in galvanizing pails, and galvanized iron baskets used for plating. Another man saw a gold plater in one shop use a platinum anode. He went to another shop and, not being able to obtain platinum, used a zinc anode, because it is the same color. I could mention many others if space would permit.

A satisfactory solution for electro-deposition of tin is made in proportions of 8 ounces of pyrophosphate of soda, one ounce chloride of tin, and one gallon of water. Additions of soda and tin are frequently needed as the solution cannot be fully maintained from the anode. A foul anode indicates too strong a current or lack of free soda in the solutions.—J. Painter.

THE ANNUAL BANQUET OF ST. LOUIS ELECTROPLATERS.

The banquet of St. Louis Branch A. E. S., held at the American Annex, St. Louis, Mo., Saturday, January 23rd, is now a matter of history and to those who were fortunate enough to be present, it will ever be held as a lasting pleasure and an educational treat.

The guests began to assemble at 6:30, and the reception in itself offered an opportunity for the exchange of that hand-shake and immediate friendship spirit for which these events are becoming notable. It also offered an opportunity for renewal of acquaintance and

Louis branch, read letters or regrets from James H. Hansjosten, supreme president; Charles H. Proctor, founder of the society; Walter Fraine, supreme secretary; G. E. Sterling, treasurer; H. E. Willmore, editor-in-chief of the "Monthly Review;" E. W. Heil, Wichita, Kan., member of St. Louis Branch, and also a telegram of good will from Chicago branch.

The opening address by E. J. Musick, President of St. Louis branch and Toastmaster of the evening, was a masterpiece in showing what the society stands for and its accomplishments to date. All the addresses and papers were received with marked attention, and the address of A. R. Morgan, Principal of McKin-



exchange of thought among the various employers, superintendents and other guests who were present. The period of time allotted for the reception was an enjoyable one, but all were looking forward to the big event. At exactly eight o'clock, all sat down to the banquet tables and a photograph was taken, after which all enjoyed the splendid repast, as shown by the menu below:

Consomme a la Potash
Oxidized Celery Pickled Radishes
Electric-Cleaned Roast Turkey
Reversed-Current Cranberry Sauce
Copper-Plated Potatoes
Wire Beans
Barrel-Plated Peas
Nickel-Plated Crackers
Polished Cheese
Cyanide of Coffee

Before beginning the regular order of the program H. H. Williams, secretary of St.

ley High School, and Robert Fischer, Instructor of the Class in Chemistry, are worthy of special mention. The program was as follows:

Introduction E. J. Musick
Trials and Troubles of a Plater H. J. Richards
Electro-Plating and Chemistry Robert Fischer
Nickel Plating and Standardizing F. Rushton
Address A. R. Morgan
Principal, McKinley High School
Electro-Coloring of Metals..... P. Tressider
The American Electro-Platers' Society
..... H. H. Williams

Following the completion of the program the following gentlemen were called upon for impromptu remarks: Leo Van Cleave, President of the Buck Stove & Range Co.; D. P. McCabe, Purchasing Agent of the Majestic Manufacturing Co.; W. Hamman, Superintendent of Quick Meal Stove Co.; Lucas Edell, Superintendent, Majestic Manufacturing Co.; P.

Evans, General Foreman, Wagner Electric Manufacturing Co.; F. Coppman, General Manager Boorsum-Pease Loose Leaf Book Co.; A. Hoffman, Purchasing Agent, Bridge-Beach Manufacturing Co.; Harry Adams, Frank Adams Co., and W. H. Musick, Musick Plating Works. The responses from these gentlemen certainly showed that they were impressed with the work of the Society, and the remarks by Messrs. Van Cleave and McCabe are worthy of special mention.

E. Lamoureux, who was instrumental in getting the branch started, was among those present. He was called upon, and confined his remarks to the national scope of the convention of the Supreme Society to be held at Dayton, O., next June, and impressed upon those present the fact that this event was open to all of them, and offered assurance that anyone who could arrange to attend would be amply repaid for any sacrifice and time devoted in that direction.

F. G. Liscomb was also among those present, as was also his smile, and both responded nobly to the call of the toast-master, and it is needless to state that his remarks, which were confined to a summing up of the various papers of the evening, were interesting and well received.

St. Louis Branch must be accorded a great deal of credit for its ability to do things. With a membership of only 30 men, and an attendance at this banquet of 75 guests, in which was represented some of the most prominent men connected with stove and other manufacturing plants of St. Louis, it was certainly shown that the work of the society has made a profound impression upon them, and the credit for this situation is due to the membership of this branch, and it surely demonstrates their standing as "Men among Men."

Banquet Incidentals..

E. J. Musick, President of St. Louis branch, was one of the busiest men of the Branch.

C. E. Weygandt, Vice-President of St. Louis branch was among those present from Belleville, Ill. Always unpretentious, but a hard worker for the branch in his own quiet and earnest manner.

Frank Rushton and his colleagues of the Arrangement Committee, were hard workers, and the fruits of their labors were in evidence on every hand.

H. H. Williams, Secretary of the St. Louis branch, and Second Vice-President of the Supreme Society, was much sought out by those present; big in physique, and possessing many sterling qualities, it is only natural that he should command attention, and that all who can would want to know him.

H. J. Richards was very much in demand. His work as Librarian of St. Louis branch is bearing fruit, and his witticisms are always thoroughly enjoyed. If Mr. Richards should attend the next convention at Dayton, O., or any subsequent convention, he will unquestionably carry away the honors as Supreme "Wit" of the society.

E. W. Heil, member of St. Louis branch, and located at Wichita, Kan., although unable to be present personally, showed his interest by letter and also by presenting a sample of his work in the shape of a Lamp Bowl filled with "A La Rotary Pudding" or in English, choicest home-made candy, which served as after-dinner mints. The bowl was afterwards used to serve the cigars, and attracted considerable attention.

NEW STYLE NAME-PLATES FOR MACHINERY, VEHICLES, BOILERS, ETC.

The Federal Name Plate & Novelty Co., of 732 Federal St., Chicago, Ill., announces the perfection and patenting of a new process for the manufacture of name-plates for machinery, vehicles, etc. The new process provides for the making of plates in bold relief, and, the manufacturers claim, enables them to produce a plate of raised letters, instead of etched letters, giving a durable surface not subject to filling in as with the etched plate.



The method of production calls for special automatic machines which produce the plates at a very fast rate. The plates are made of a special hard metal alloy which will withstand an extremely high temperature and will resist heat to a greater degree than brass.

After the plates come from the machines (they can be made any thickness) they are finished in copper, brass or silver finish. They can be polished and will remain bright and readable for all time.

These plates are now being made for many manufacturers of machinery, vehicles, etc., with their trade marks, and can be made in almost any style because of the flexibility of the process. The Federal Name Plate & Novelty Co. will gladly furnish samples, literature and estimates on request.

QUESTIONS AND ANSWERS.

Thin Nickel Deposit.

I am nickel-plating hollow-ware, and after leaving the work in the tank for an hour, with solution at $6\frac{1}{2}$, there is scarcely any deposition. There seems to be a resistance, but I cannot find where the trouble is.

You can correct your solution by reducing to 4 Beaume, and then adding single and double nickel salts, 7 oz. each per gallon. Put these in a bag, and allow them to dissolve in tank over night. An addition of 4 oz. boracic acid will also be of service.

Cleaning Small Steel Springs.

We have some small steel springs to copper plate. They have been oil tempered and the oil appears to have soaked in, so that they do not respond to usual cleaning methods. Kindly recommend a method of cleaning these springs.

Make up a strong pickle of 3 parts sulphuric acid to 1 part of water, and allow the springs to remain therein for 20 to 30 minutes. Rinse in clear water and pass them through a mixture of 2 parts hydrochloric acid and 1 part of water. Rinse again and they will be ready for copper plating.

Brass Plating Die Casting.

Kindly give method of brass plating zinc alloy die castings. Give formula for preparing solution.

First make a copper plating solution from the following formula. Cyanide of copper 3 oz., carbonate of potash 1 oz., cyanide of potash 4 oz., and water 1 gal. Dissolve the potash and copper in one half the amount of hot water and the cyanide in the balance of luke-warm water. Mix thoroughly together. Then dissolve equal parts of cyanide of zinc and cyanide of potash in warm water. Add 1 oz. of zinc carbonate and 1 oz. of cyanide to the copper bath per gallon, then add $\frac{1}{2}$ oz. of sal ammoniac per gallon of solution. If the color be too deep a yellow, more zinc should be added to obtain the required shade. The bath should be used at a temperature of 120 deg. F. and 2 to 3 volts.

Metal For Gas Connections.

We are making a mixture of 88 per cent copper, 10 per cent tin and 2 per cent zinc. Just before pouring, we drop in about 1 lb. of phosphorus copper. Our castings are used for gas connections and leak at 100 lb. pressure. Will you kindly state at what temperature this metal should be poured with the pyrometer or what mixture in yellow brass can be made that will hold?

You are using what is known as gun metal. On account of the large percentage of tin in this mixture, this is a low melting bronze, which melts at about 1500 to 1550 deg. F. You are probably pouring it much too hot and this is what causes the casting to fall down under pressure.

We scarcely think it is necessary for you to use such an expensive mixture for this work. The mixture of 85 copper, 10 zinc and 5 tin would give you more satisfaction, adding 2 per cent of lead if machining is to be done. A good yellow mixture of copper 68, zinc 30, lead 2 would probably give good results also. You do not say how much metal you have in the pot when you add the pound of phosphor copper. Too much phosphorus is worse than none at all as it would make the castings porous. You need only $\frac{1}{4}$ lb. of 5 per cent phosphor tin or phosphor copper for each 100 lb. of metal in the pot.

Bronze Mixture.

We are sending you a diagram of gas bowl for gas buoy. What is the best mixture of metal to use for this purpose? What we have made so far has turned out to be porous and will not hold the gas. The weight of the casting is 90 lb.

For the class of work you desire, a good close bronze is needed which should be poured at as low a temperature as possible to get a perfect casting. A mixture of 88 per cent copper, 7 per cent tin, 3 per cent zinc and 2 per cent lead will be suitable for your purpose, adding $\frac{1}{4}$ lb. of 5 per cent phosphor tin to every 100 lb. of metal. Put into the pot after skimming and just before pouring. This will improve your casting.

Aluminum for Nickel Plating Rack.

We are figuring on making a rack for nickel plating pipe, and are wondering if we made this out of aluminum, would it have any effect on the nickel solution. We understand it is impossible to plate aluminum in an ordinary nickel solution, and would like to know, besides the above, whether the aluminum would affect the plating and whether it is a good conductor.

Aluminum is a good conductor, and will not affect your nickel solution. It may be plated in the solution, but the deposit will not adhere. A brass wire rack is better for your purpose, it being a better conductor than aluminum.

Tinning Tableware.

Kindly give us a formula and method for tinning spoons and forks.

Steel spoons and forks are tinned as follows.—The steel is cleaned by pickling in dilute sulphuric acid and is then immersed in a flux made by dissolving chloride of zinc in water to saturation. Without rinsing, they are then immersed in molten tin until covered. They are found coated with tin, but rough. To smooth them, it is necessary to immerse each one separately in a second tinning kettle containing molten tin and covered with tallow to a depth of about 1 in. This gives a very smooth and bright coating of tin if the metal is kept at the right heat.

Melting Scrap Nickel.

We wish some information regarding the melting of old scrap nickel, such as is used in making hot tubes for gas engines. We wish to re-melt this and cast it into sheets, and would like to know the conditions under which it would have to be handled.

The nickel is melted in crucibles, but you will probably have to have a forced draught to your furnace in order to obtain the necessary heat. In melting, use a flux of 3 parts of lime and 1 part of fluor-spar, well mixed. This will serve to clean the metal and keep it from oxidizing when melted. Use 2 or 3 lb. of this to 100 lb. of the nickel.

Cracks in Aluminum Castings.

In making aluminum castings, we have great difficulty in avoiding cracks in the castings.

Kindly give us formula for a mixture that will cast without cracking in the mold.

Your mixture probably contains zinc, which gives the tendency to crack. You will do much better with the following mixture:

Aluminum 93 lb.
Copper 7 lb.

Cyanide Copper Solution.

Please give me a formula for good cyanide copper solution testing 16 deg. Beaumé.

Dissolve 2 lb. of cyanide in 1 gallon of water and then add carbonate of copper (preferably plastic), to it until it will take up no more. Dissolve cold or the solution will become hot while the dissolving is taking place and turn the carbonate black. Enough carbonate is dissolved in it so that it will take up more, stopping at the point when there is a very slight quantity of the carbonate of copper undissolved. Now add 4 oz. of cyanide in addition for free cyanide. Then add 2 oz. of bi-sulphite of soda and the solution is ready. If you find the anodes do not keep clean, add a little more free cyanide. If the solution is stronger than 16 deg. add water to reduce.

McKinley Gold.

What is the McKinley gold finish and how is it produced?

The McKinley gold is obtained by using a large amount of ammonia in a brass solution. In this way about equal amounts of zinc and copper are deposited, giving a golden color to the work. The solution is difficult to work, the trouble consisting in the maintenance of the color.

The original mixture for bearings, recommended by Isaac Babbitt, consists of 50 parts tin, 5 parts antimony, and 1 part copper.

Zinc-dross is an alloy of zinc and iron and not a real dross. When the two metals come in contact some of the zinc is dissolved by the iron, the melting-point of the zinc being raised, and the alloy becomes pasty at the ordinary melting temperature of zinc. This alloy is then removed from the zinc kettle in the form of a pasty mass called zinc dross.

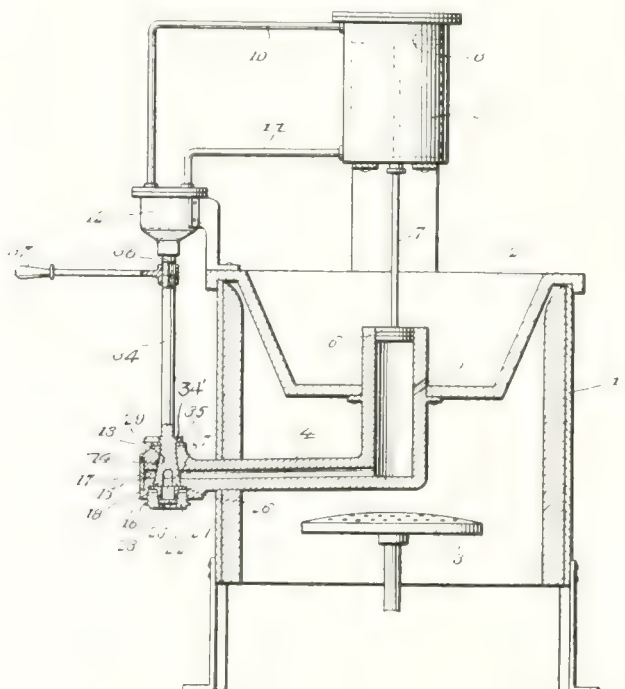
PATENT NOTES.

Process of Removing Zinc from Zinc-Coated Material.

In this process use is made of a solvent of zinc which has a basic reaction, and is not a solvent of iron. The solvent used is a solution of zinc chloride containing 24 parts of zinc to 25 parts of chlorine, and therefore having a basicity of one per cent. The material is placed in a drum containing about a ton, and this is placed in a bath of about six cubic meters of solution, where it is allowed to remain until the zinc is removed from the material. U. S. Patent 1,122,340. Dec. 29, 1914. J. Weber, Essen, Germany.

Die-Casting Machine.

This apparatus for making die-castings, is of the type in which the molten metal is ejected from the metal pot through an outlet by means of an expelling plunger operated manually or by pneumatic power. In this machine

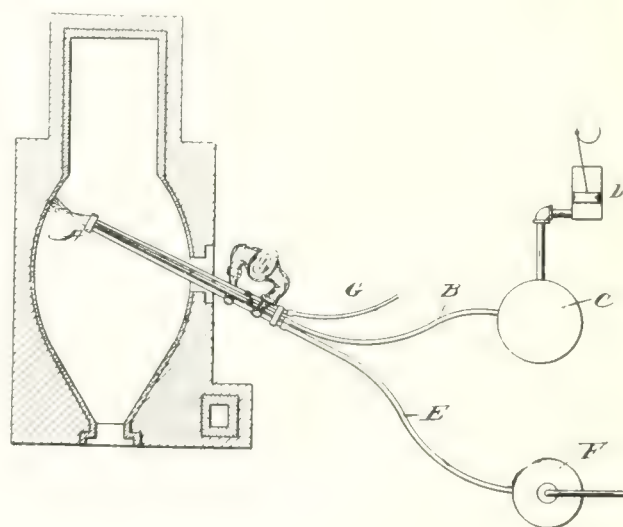


there is a valve of novel construction, whereby the metal may be discharged to cast either horizontally or vertically. An attachment is also provided, to enable the machine to pro-

duce vertical overhead castings.—U. S. Patent, 1,121,455. Dec. 15, 1914. James Bate, Detroit, Mich.

Process of Forming and Repairing the Linings of Furnaces.

A homogeneous lining of the requisite density is given to a furnace by applying to its walls comminuted refractory material at high velocity continuously or successively in relatively small quantities. This material is subsequently subjected to a fusing temperature, thus



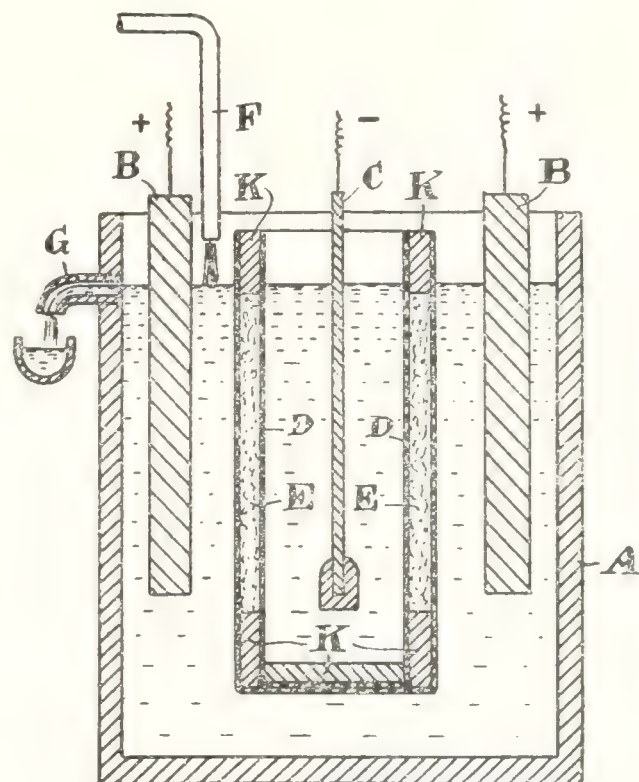
producing successive thin layers of refractory material in a softened state, into which the refractory material which follows is embedded, building up a homogeneous lining. Use is made of an injector furnished with compressed air, and also with a torch for softening the material.—U. S. Patent 1,125,741. Jan. 19, 1915. Alfred Schwarz, New York City.

Process of Recovering Native Platinum Metals.

This invention relates to a process of recovering platinum from natural deposits such as black sand or placer gravel. An alloy is made first with some other metal, such as zinc or bismuth, and this alloy is then readily amalgamated with mercury. The zinc is preferably brought into contact with the platinum ore in the form of zinc amalgam, and in the

A molten bath of copper, vanadium and aluminum at a temperature of 2100 deg. F., is formed, containing about 8 to 25 per cent vanadium, 6 to 12 per cent aluminum, and the balance copper. The metal to be coated, at a temperature of 1500 deg. F., is immersed in the bath for 3 to 5 minutes, removed and then again immersed for about one minute.—U. S. Patent 1,126,484. Jan. 26, 1914. John Kirby, Pittsburgh, Pa.

In a process of electrolyzing copper solutions containing iron in the form of ferric salts, use is made of a diaphragm separating the cathode from the anode. A continuous flow of solution is maintained through the cell on the anode side only, and the solution on the cathode side is affected only by changes due to diffusion.



The diffusion rate of the copper being deposited is greater than that of the ferric salt in the solution, so that the ferric salts do not enter the cathode compartment.—U. S. Patent 1,123,299. Jan. 5, 1915. N. V. Hybinette, Christiania, Norway.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY.

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES.

New York—Meets fourth Friday of each month at Broadway Central Hotel, New York City, at 8 P. M. Secretary, Joseph Minges, 148 Schenk Avenue, Brooklyn, N. Y.

Rochester—Meets second Friday of each month at Hotel Rochester. Secretary, C. V. Haring, 306 Dewey Avenue, Rochester, N. Y.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets, Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th. and Spruce Sts., Philadelphia, Pa., 8 P. M. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Dayton—Meets first and third Wednesday at the Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 Madison Avenue, Irvington, N. J.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 1st Street. Secretary, Geo. J. Kutzen, 518 Alfred Street, Detroit, Mich.

Chicago—Meets fourth Saturday of each month at Western Building, Randolph and Michigan Aves. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Indianapolis—Meets twice a month on Friday evenings. Secretary, pro tem., J. C. Davenport, 349 Massachusetts Ave., Indianapolis, Ind.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, John G. Murphy, 71 Dingens Street, Buffalo, N. Y.



Third Annual Banquet of Chicago Branch, of the American Electroplaters' Society.

Milwaukee—Meets first Friday of each month at Eagles Hall, 137 Second Street. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Ave., Cincinnati, Ohio.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, H. H. Williams, 2134 Nebraska Ave., St. Louis, Mo.

Bridgeport—Meets on the third Friday of each month at the "Brass World" office, 260 John St., Bridgeport, Conn. Secretary, Nelson Barnard, 858 Howard Ave., Bridgeport, Conn.

Cleveland—Meets second and last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Ave., Cleveland, O.

The regular monthly meeting of the New York branch was held January 22nd, at their rooms, 262 Pearl St., cor. Fulton, where the branch hopes to fulfill its expectations of having a laboratory for experimental work and demonstrating on the various subjects which come up for discussion. The branch has decided to hold two meetings each month, the second and fourth Friday evenings, the first

to be devoted to laboratory work and the last to be devoted to the general business of the society. It was decided to raise the entrance fee from \$1.00 to \$5.00, to take effect immediately.

The banquet committee reports that arrangements are completed for the annual banquet to be held at the Broadway Central Hotel on Saturday evening, Feb. 20th.

The Cleveland Branch is growing every day, new members are joining, and though still an infant, it will be heard of in the future.

At the last meeting the following officers were elected:

W. D. Scott, President,

W. J. Wicks, Vice President,

Chas. Werft, Secretary and Treasurer,

James Purcell, Librarian,

H. J. Ter Doest, P. Fitzgerald and Fred Heckel, Board of Managers.

This branch will meet the second and last Saturday of every month at the Central Y. M. C. A., corner Prospect and 22nd Sts., Room 217.



Held at the Grand Pacific Hotel, Chicago, Ill., December 12, 1914.

The Bridgeport Branch of the American Electroplaters' Society has held two important and well-attended meetings since our last issue. On Jan. 15th, after the usual formalities of business, Nelson A. Barnard, the secretary read to the members the paper of Dr. Watts on "Nickel Solutions" presented at the Chicago Banquet. An interesting and spirited discussion followed.

On Feb. 5, this live branch took another step forward by the commencement of a series of ten lectures given by Dr. F. C. Stanley on the chemistry of electroplating. The meeting commenced promptly at 8 p. m. and after being introduced by President Stratton, Dr. Stanley spoke on "The Composition of Matter and the Rules for Naming Substances." Few men have his ability in making complex things simple. Under his word-magic, elements become personalities, atoms had their marriages, divorces and affinities and plating solutions assumed the form of possible allies instead of the appearance of armed and dangerous neutrality. After the lecture, the meeting was thrown open to discussion and the questions and answers afforded a second mental treat. The attendance of the branch promises to increase rapidly as a result of the enthusiasm manifested. Chris Wyrzten, the poet of the branch, was heard declaiming on the way home—

"It's the H and the 2 and the O
That are used to make water, you know.
The C and the L, the N and the A
Mixed with above make oceans, they say.
Liquor changes your "ate" to a "hic"
But chemists tell us "ate" comes from "ic";
In every change in elements' fight
Remember for aye—"ous" makes an "ite".

Which goes to show that the heaven of chemical instruction has begun its deadly work. Next lecture Feb. 19th on "Acids, Bases and Salts and their Relations."

◆◆◆ "BUCKEYE" PRODUCTS. ◆◆◆

We have just received a set of leaflets issued by the Buckeye Products Co., Cincinnati, O., describing and illustrating the special foundry supplies of the company. These include furnace cement, parting compound, snap flask guides and crucible furnaces for metal melting with fuel oil, artificial, natural or producer gas. A complete set will be sent to interested readers on request.

INFLUENCE OF ALUMINUM ON GERMAN-SILVER.

Aluminum hardens german silver very rapidly and makes it hard to machine. Added in proper proportions, however, it can be depended upon to fulfill the function expected—that of imparting soundness to the sand castings.

The chief error in using aluminum for alloying purposes has always been in using too much of it, and the results must always be the same tendency to crack, undue and uneven shrinkage and dirty castings.

Aluminum can be best added in the form of an alloy between the zinc and the aluminum. For instance, if the white-metal formula should consist of

Copper, 50 per cent; Zinc 34.90 per cent; Nickel, 15.00 per cent; Aluminum, .10 per cent.

An alloy should be made containing 19 lb. of zinc and 1 lb. of aluminum. Melted together and poured into small ingots the alloy can be broken up in small pieces and added as desired. One of the peculiar features of metallurgical work is the observance of the small quantity of metal necessary to bring about radical changes in the quality of the products. An excess of aluminum will make the alloy brittle while too little will result in unsound casting.

◆◆◆ CHEMISTS' MEETING AT MIDDLETOWN. ◆◆◆

The twenty-ninth meeting of the Connecticut Valley Section of the American Chemical Society was held at Middletown, January 23rd, 1915.

The Middletown members provided for an inspection of Wesleyan University buildings and campus, with a demonstration of the liquid air plant and properties of liquid air.

After this, a swimming meet at the gymnasium was witnessed. A sociable dinner fest was held at Stueck's at 6 p. m. The business meeting developed two interesting contributions:

"The Development of the Dye Industry Abroad" by Dr. M. L. Crossley, and

"The Radio Elements and the Periodic Table" by Dr. H. L. Ward.

The secretary of the section is J. C. Andrews, from whom details can be obtained as to membership and meetings.

ALUMINUM DIE CASTINGS.*

By A. B. NORTON.†

The term "die casting" is used to designate a type of castings which are made in permanent metallic molds. As such, it embraces a wide variety of work which is assuming more and more importance. The development of the industry is proceeding so rapidly that producers and consumers in general lack definite information as to the alloys used, or the advantages, possibilities and limitations involved.

Four main classes of alloys are now in use. The bases of these alloys are namely (1) zinc, (2) tin, (3) lead, (4) aluminum.

The zinc, tin and lead base alloys are low melting and of low shrinkage. The problems involved in making them were therefore attacked early and castings of this type have been on the market for some time. They are mostly small parts used in places where they are not required to possess much strength or rigidity and, as such, when properly made, they serve the purpose for which they were intended very well. The lack of strength, the low melting point, and heavy weight (with its consequent cost) of these alloys, have made aluminum die castings very desirable, but the difficulties involved in their manufacture have retarded the development of the industry to such an extent that at present the Aluminum Castings Co. has the only plant in America in which the manufacture of large aluminum die castings is being carried on commercially.

The principal difficulties met with are (1) the high melting point of aluminum (as compared to tin, lead and zinc), (2) the tendency of molten aluminum to absorb iron, (3) the relatively high shrinkage on solidification, and (4) the weakness at the solidification point developed by aluminum when burned or soaked.

The first two features mentioned have hindered the direct adaptation of pressure machines of the iron plunger type, since certain parts of these tend to wear out rapidly, due partly to solution of the iron or steel in molten aluminum, and partly to oxidation about the heat source.

The high shrinkage on solidification and the weakness of burned or soaked aluminum dur-

ing that period, have been fruitful sources of trouble in the form of cracked castings.

Some attempts to remedy the shrinkage have been made by using alloys developed for that purpose. An alloy of about 7 per cent cadmium with a small percentage of manganese, was evidently designed with this purpose in mind. The manganese, though beneficial in a different way, would tend to lessen the advantage gained from the cadmium. About 2 per cent of tin has likewise been added to an 8 per cent copper alloy. This tends to help by causing the aluminum to stretch rather than crack, but its effect is not apparent in a well designed mold.

Zinc is a common and useful hardening element for aluminum castings made in sand, but its use in die castings is prevented by the shortness of zinc-aluminum alloys. It is not unknown in the field, but it is extremely difficult to handle.

The alloy used almost entirely by the Aluminum Castings Co. is practically No. 12. This particular composition is desirable from many viewpoints. It can easily be prepared without overheating any portion of the component metals. It is strong while solidifying, strong at high temperatures, and also at ordinary temperatures. The practice has been perfected with the use of it, and a change in the alloy would necessarily mean some revision of methods and manipulation.

The process of manufacture of aluminum die castings is difficult to describe, since each job is a problem of its own and must be worked out individually.

The molds are made of iron. They are constructed in sections containing a large number of loose pieces, the number varying, of course, with the size and complexity of the casting.

The loose pieces serve several purposes. They may be used as cores, as chills, or to form projecting parts which otherwise would interfere with the opening of the mold.

The operation in brief, then, is to assemble the mold, heat it to the proper temperature, insert the cooling pieces and pour the castings. The loose pieces are then removed in the proper order at the proper times, and the die is taken apart for removal of the casting. In order to get more complete control of the

*A paper presented at the Annual Meeting of the American Institute of Metals, September 7-11, 1914, at Chicago, Ill.

†Aluminum Castings Co., Detroit, Mich.

operation, most of the molds now in use are mechanically operated. The method of mechanical control we are not at liberty to discuss.

It is evident from the preceding description that the aluminum die castings must be made in molds which are a perfect machine fit. The mechanics employed must be of the highest class. The mold itself will not work at all unless very accurately constructed. The castings produced must therefore conform to this same high standard of perfection, as to dimensions.

The accuracy attainable in the making of an aluminum die casting results in a considerable reduction of the number, extent and expense of the machining operations required. It is possible to meet dimensions in most cases with a very slight variation. The necessary allowance for finish is therefore, in many cases, zero, and, as a consequence, the customer gets a casting of the minimum weight consistent with his requirements. Since the castings are all alike, they fit the jigs accurately and readily, thus saving time and increasing the accuracy of the necessary machining operations.

The metal used in die castings has to be handled with the greatest of care, and, in general, does not come in contact with any sand. Consequently, sand inclusions and hard spots cannot be present to dull tools or knock them out of alignment.

The molds impart to the metal a very smooth surface and an exceedingly close grain. This fine grain takes a brilliant polish readily and rapidly. It is also practically impervious to water and oil, due to the fineness of structure, combined with the freedom from dross and dirt.

Comparative figures of the physical properties of die castings and sand castings follow :

	Sand Castings	Die Castings
Tensile Strength	20,000*	25,000**
Approximate Elastic Limit (Stress for .01 in. elonga- tion in 2 in.)	13,000*	13,000**
Per Cent Elongation in 2 in.	1.7*	3.1**
Specific Gravity	2.84	2.87

* Average of hundreds of bars.

** Average of 48 test bars:

The above table shows that aluminum die castings are much stronger than the sand castings, and, in fact, pound for pound, they exceed cast iron and ordinary brasses and bronzes.

The high strength, resistance to heat, light weight and beautiful color of the aluminum permanent mold products have caused their adoption already in numerous classes of work. This includes many types of electrical, scientific and measuring instruments, cash registers, automatic vending machines, typewriters, adding machines, cooking utensils, automobile and aeroplane parts.

One of the newer adaptations is in the manufacture of pistons for automobile engines. Die cast aluminum pistons were used successfully in most, if not all, of the French racing cars in the recent 500 mile event at Indianapolis.

The process, like any other, has its limitations. Getting a job under way involves a considerable expenditure and hence prevents the acceptance of small orders. The design and preparation of the dies is an expensive process and usually the casting desired has to be altered to adapt it to this form of manufacture.

The process in America at present is limited largely to pieces in which the coring can be designed so as to permit the use of metallic cores. In France large oil pans have been made in which sections almost entirely enclosed were obtained through the use of sand cores. Some pieces are being made here with sand cores, but it is far preferable, where possible, to redesign a job so as to obtain all of the advantages afforded by all metallic molds.

The production of commercial castings, as outlined above, is not a mere matter of getting a certain mysterious machine adaptable to all purposes and setting it to work. On the contrary, each individual job requires a separate solution. Here the first big factor is the experience of the engineer who designs the mold. He requires also the co-operation of the engineer who designed the casting in order that changes required will be made whenever possible. After the mold is made, the best conditions for operation must be determined and the operators must be trained to handle them. This experimenting is necessarily extremely expensive, and would be prohibitive but for the high production obtained from a mold once it is in working order.

The process as described contains features which may be profitably adapted to brass die casting work, but our experiments in this particular are incomplete as yet.

Castings weighing about 30 pounds each are now being turned out in large numbers. These in general replace sand castings weighing

about 25 per cent more. An iron sand casting of the same volume would weigh close to 100 pounds and would be only about 30 per cent stronger.

Aluminum die castings will therefore solve many manufacturing problems and their obvious advantages assure their adoption in many lines of industry.

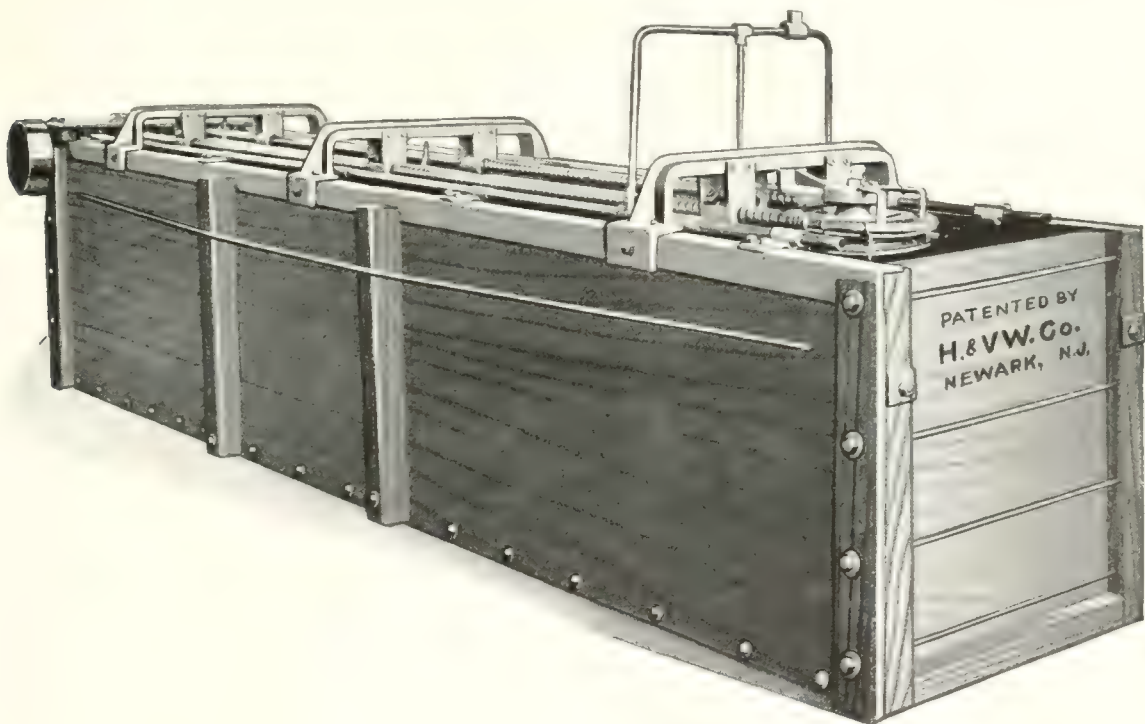
MECHANICAL PLATING.

The illustration below shows the new conveyor apparatus of the Hanson & Van Winkle Co., Newark, N. J., concerning which an article recently appeared in our journal. The company has recently brought out a new leaflet

The company is ready and willing to demonstrate the new apparatus to those directly interested, at the Newark factory, 269 Oliver St., Newark, N. J. and at the Western branch, 110 N. Clinton St., Chicago, Ill.

To secure good results babbitt must be poured at the correct temperature. Too high temperature will produce shrinkage as well as oxidized and dirty metal with its anti-frictional qualities lowered, while too low a temperature will produce a coarse granular formation.

Ductile tungsten is practically insoluble in all the common acids; its melting-point is higher



describing this device, which was designed to handle immense quantities of work in the plating bath.

As an example of the value of the automatic screw conveyor, it is mentioned in the leaflet that in one installation 115,000 valves are plated in a nine-hour day. Moderate sized work such as builders' and plumbers' hardware, automatic valves and parts, machine parts, typewriter parts, etc., are best handled by the machine, and show its utility.

The constant movement of the work through the solution permits a higher voltage to be used than in the still tank, thus employing a greater ampere current and shortening the time of deposit.

than that of any other metal; its tensile strength exceeds that of iron and nickel; it is paramagnetic, can be drawn to smaller sizes than any other metal (.0002 in. diameter), and its specific gravity is 70 per cent higher than that of lead.

The metal used in auto igniters, cigar lighters and acetylene lamps for producing sparks when struck by a steel wheel, is an alloy of 70 per cent cerium and 30 per cent iron. It has recently been proposed to utilize the alloy for igniting motor headlights and as a substitute for electric ignition in the cylinders.

THE TREND OF FACTORY SANITATION.

The annual convention of the American Society of Heating and Ventilating Engineers, which has just been held in New York City, is the best index possible to the trend of industrial thought and practice towards establishing and maintaining sanitary methods of heating and ventilating throughout the factories of the country.

This society represents the most advanced thought and experimentation in heating and ventilating practice, and like all other societies of a progressive type, has encountered much opposition in its work from the very people it is intended to benefit. It has proved just as difficult to induce people to breathe pure air and live in a normal working temperature as it was originally difficult for the sanitary engineers of the country to induce people to be clean and insist on cleanliness in their surroundings and for their employees.

It is not so many years ago that factory owners rebelled against plumbing and other sanitary regulations which demanded that factories and offices should be equipped with sanitary lavatory and toilet accommodations. In large cities of the United States, such objections have disappeared as the improvement in the habits and efficiency of the employees under a sanitary regulation and environment has abundantly demonstrated the dividend that can be declared by such sanitary expenditure.

It is only recently that an attempt to make sanitation a national matter has been made and the first steps toward this desirable end have been taken by the State of Ohio, when it appointed a State Sanitary Inspector, whose work and rulings are now affecting every village, town and city. The unhealthy and filthy conditions now prevailing in small outlying factories and tenement districts will soon be abolished.

Difficult as it has been to secure sanitary plumbing and garbage removal, it has been still more difficult to convince people that they should exercise similar care in obtaining fresh air indoors and temperature regulation. Probably no factor has been more powerful in assisting the bringing about of change in heating and ventilating than the much maligned sky-scrapers in our large cities. We are tempted to scoff unthinkingly at their height and magnitude, but nevertheless, the over-

coming of sanitary difficulties in these huge structures has brought about a concentration of thinking along these lines which is nationally beneficial. Some of our tall office buildings house and serve daily as many people as inhabit a small town. Plumbing, heating, ventilation, sewage disposal, water supply and garbage disposal are imminent problems in such structures. Inefficiency or malconstruction in any of these will prove fatal to the health of the occupants and their clients. The employees of such buildings, surrounded and served by sanitary equipments daily, equipments costing thousands of dollars, are no longer satisfied to return to their homes and submit to unsanitary conditions, filthy alleyways, unswept streets, poor drainage, poor water supply and germ-laden air. Men are demanding everywhere as good conditions for their families as they obtain in their offices.

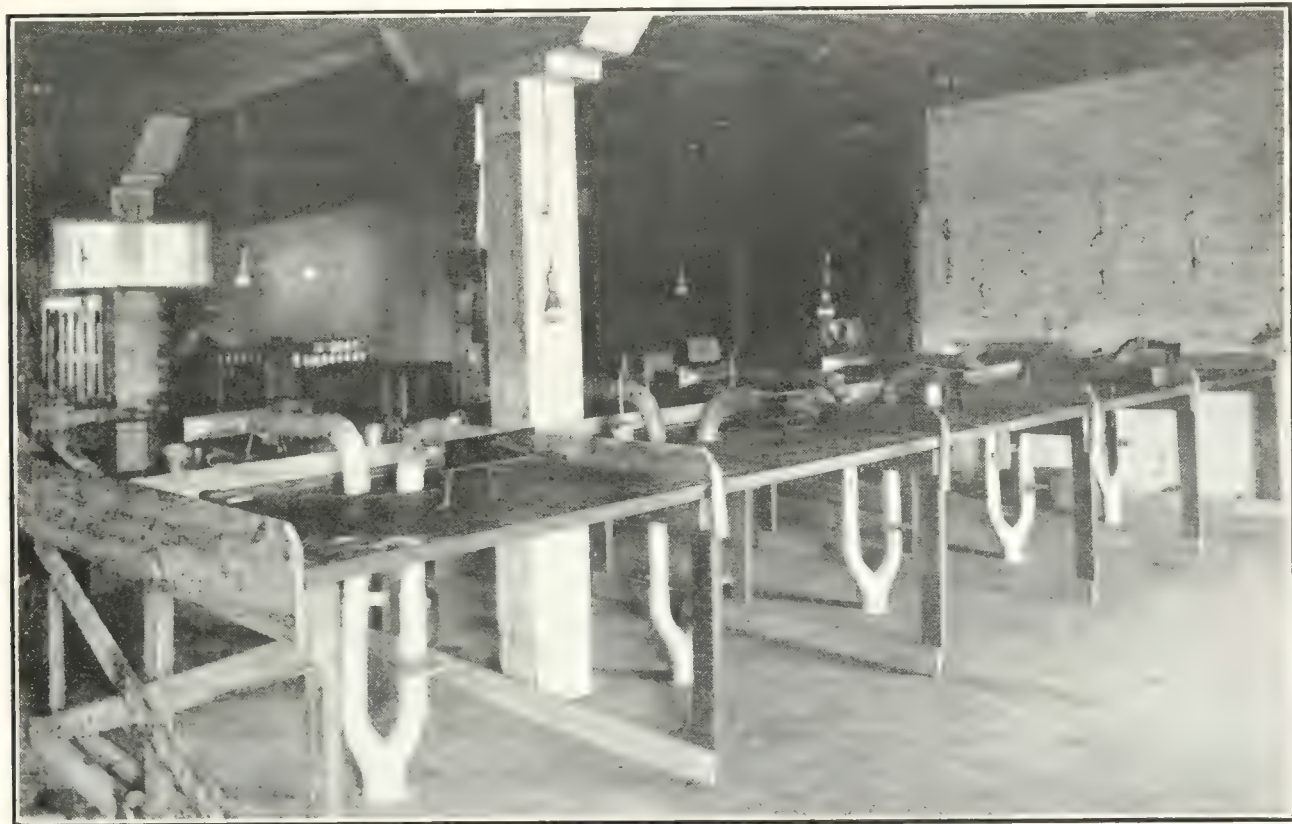
Owners of factories operating under sanitary conditions in their office buildings in the cities are more amenable to advice and suggestions on improving the working conditions of their employees. The up-to-date factories, now being built, embody all the latest improvements worked out by our sanitary, heating and ventilating engineers, knowing that such improvements mean alertness of effort, uniformity of operation, minimization of working risk and loss by reason of absence through sickness, and general contentment and satisfaction of the employees. All of this work of improvement has been voluntary so far. The time is at hand when there will be compulsory heating and ventilation laws throughout the country, and factory owners will do well to study some of the suggestions which have been made by the Committee of the American Society of Heating & Ventilating Engineers at its recent convention in New York, in which basic suggestions have been made for the guidance of committees undertaking to put in force such compulsory legislation.

The floor area per occupant of factories is suggested as 25 square feet and the cubic space allowance 250 cubic feet. All figures given are minimum requirements.

Sufficient outdoor air shall be provided for all occupied rooms or enclosed places at times during occupancy to the minimum amount of 1500 cubic feet and such air supply must be from an uncontaminated supply, from which dust and other impurities shall be removed by washing or otherwise as directed and approved by the department of health.

In the distribution of this air supply, it must be so balanced that a temperature maintained with uncomfortable drafts or any draft lower than 60 deg. F. shall be avoided, and the amount of carbon dioxide is limited to 10 parts to each 10,000 parts of air. Tests for carbon dioxide must be made from 3 to 6 ft. above the floor line in the occupied spaces. It has been established by many tests that car-

Dust, fumes, gases, fibers, odors, vapors or other impurities which are generated or released in the course of industrial operation shall be removed by exhaust fans, pipes and hoods from the point of their origin and care must be taken to discharge such impurities above the roof or at such point that the fresh air supply of the building itself or of adjacent buildings will not be in danger.



Showing Exhaust Ventilating System Installed by the Cleveland Blow Pipe and Mfg. Co., Cleveland, O., in the Plant of the Maple City Mfg. Co., Monmouth, Ill. This System Exhausts the Acid Fumes from the Soldering Benches and the Gases from the Vats and Tanks. The Main Piping and Fans are Under the Floor, Separate Connections Being Made to Every Machine.

bon dioxide in reasonable quantities is not injurious to the health, but its presence in occupied rooms is an accurate measure of air supply and distribution, if no other source of carbon dioxide is present except the occupants of the room.

The best temperature for factory efficiency is between 60 and 72 deg. F. and these minimum and maximum temperatures will be demanded when artificial heating is in operation. It is manifest that such temperature ranges could not be enforced in factories, boiler or engine rooms in every case, but individual cases will be submitted for the consideration of the department of health and adjustment made accordingly.

Special attention is also called in cases when industrial operation produces excessive heat, or humidity, or both, and means and appliances will be suggested for the maintenance of such factories or work rooms in as healthful condition as possible.

The toilet rooms and lavatories must be independently ventilated and properly lighted and all existing buildings will have to modify unsanitary equipments to conform to the minimum requirements of the new laws that may be passed.

Cellars and basements must be ventilated and maintained in a dry and sanitary condition.

All plans of new buildings must be submitted, drawn to scale on cloth in permanent lines and lettering so that every detail of heating and ventilation shall be approved before the building is erected to insure its sanitary working condition.

As regards humidity control, little is said, save that the range of 35 to 50 per cent is desirable wherever possible. There are too many factors entering into the consideration of humidity and its control to make it advisable to any more than suggest the best range of humidity conditions. The relation of temperature to humidity is not a constant under all conditions, but it may safely be assumed that with proper heating and ventilation, extraordinary humidity conditions will force individual regulation by the factory operators.

The society is to be congratulated on its concise setting forth of heating and ventilating essentials. Factory owners can consider profitably the pecuniary advantage of studying the conditions of their own factories and endeavoring to make them conform as far as possible to the suggestions of the most advanced body of heating and ventilating engineers in the world today.



EXTRACTING METALS FROM LIVING BODIES.

A process of extracting poisonous metals, such as lead, copper, arsenic, antimony, silver and mercury from living bodies, and thus preventing metallic poisoning, is the recent invention of T. M. Clague, Newcastle-upon-Tyre, England.

The method is electrolytic, the two poles of a source of current being connected to liquids into which are immersed separate parts of the body; the part chiefly affected is in contact with the liquid connected with the negative pole.

In the case of lead poisoning the feet are placed in a bath of water containing a little common salt, and a metallic plate connected with the positive pole is put in the bath; the hands are put in another bath connected with the negative pole. On passing a current, which may be about 20 volts, the lead is deposited in the negative bath.

NEW CORPORATIONS.

The Miller Brass Fitting Co., New York City, capital \$6,000, will manufacture metal fittings for chandeliers, plumbing work, auto supplies, etc. Isador Speiss, Samuel Miller and David Miller are officers of the company.

The National Bronze & Aluminum Co., Cleveland, O., has increased its capital stock from \$10,000 to \$59,000.

Magnus Company, Inc., Chicago, Ill., capital \$5,000, will manufacture and deal in metals and metal products. Will H. Clark, Paul R. Winegardner, William F. Kennedy are the incorporators.

G. M. Gest, Ltd., Montreal, Canada, has been incorporated with a capital stock of \$100,000 by Walter R. L. Shanks, Francis G. Bush, George R. Drennan, and other, to manufacture metals and electrical goods and other appliances, etc.

Magnus Company, Inc., Manhattan, New York, will manufacture iron, copper, lead, zinc, brass and other metallic castings, car and locomotive brasses and journal bearings, etc., for railways, steamships, etc., and general line of railway equipment and supplies. Capital stock is \$3,000,000. Incorporators—H. S. Ogden, J. M. Ferry, G. H. Makepeace, New York City.

Articles of incorporation have been filed by the Standard Plating and Brass Foundry of Anderson, Ind., capital stock \$5,000, to do a general manufacturing business. The incorporators are: G. A. Robinson, O. H. Furr and A. H. Gillispie.

The Street & Kent Mfg. Co., Chicago, Ill., has been incorporated with \$20,000 capital, to manufacture brass, copper, lead, iron goods, and general plumbing supplies. Conrad D. Street, Thomas N. Kent and Wm. B. Dale are the officers.

The Rex Typewriter Co., Chicago, has been incorporated by W. E. Heilman, C. Paul Parker and Ernest J. Andrews, 53 West Jackson Bd., with a capital stock of \$800,000, to manufacture typewriters.

SOME TRADE FORMULAS.

By ALFRED BEAULIEU.

In my work of going from plant to plant I have had frequent opportunity to gather details on processes and formulas used. I know how the Committee on Research of the Brass World and Platers' Guide is constantly at work gathering data on all matters pertaining to the industries it represents and believe that the publication of these formulas may be beneficial even though only provoking criticism and comment. These formulas represent the working practice of many different factories. On the aluminum brasses, there is considerable difference even when the factories are turning out apparently the same class of goods. I would be interested in reading a discussion on the basic factors of use of these alloys. The other alloys bear the title of their specific application.

Aluminum Brass.

Aluminum	5 lb.	10 oz.
Zinc	26 lb.	10 oz.
Copper	67 lb.	12 oz.

Aluminum	3 lb.	5 oz.
Zinc	33 lb.	5 oz.
Copper	63 lb.	6 oz.

Aluminum	3 lb.	0 oz.
Zinc	30 lb.	0 oz.
Copper	67 lb.	0 oz.

Aluminum	1 lb.	8 oz.
Zinc	27 lb.	8 oz.
Copper	71 lb.	0 oz.

Aluminum	1 lb.	8 oz.
Zinc	28 lb.	4 oz.
Copper	70 lb.	4 oz.

Aluminum	2 lb.	8 oz.
Zinc	27 lb.	8 oz.
Copper	70 lb.	0 oz.

Aluminum	1 lb.	0 oz.
Zinc	42 lb.	0 oz.
Copper	57 lb.	0 oz.

Aluminum	1 lb.	2 oz.
Zinc	44 lb.	8 oz.
Copper	54 lb.	6 oz.

Brass Founder's Alloys.

Copper	66 lb.	10 oz.
Zinc	33 lb.	0 oz.

Brass Hinges Mix.

Copper	76 lb.	0 oz.
Tin	3 lb.	0 oz.
Lead	3 lb.	0 oz.
Zinc	18 lb.	0 oz.

Brass (Preston).

Copper	75 lb.	11 oz.
Zinc	24 lb.	5 oz.

Brass Propellers.

Copper	57 lb.	4 oz.
Tin	7 lb.	4 oz.
Zinc	35 lb.	8 oz.

Brass for Straps and Glands.

Copper	88 lb.	1 oz.
Tin	10 lb.	12 oz.
Zinc	0 lb.	11 oz.

Fine Yellow Brass.

Copper	69 lb.	0 oz.
Zinc	29 lb.	0 oz.
Lead	1 lb.	0 oz.
Tin	1 lb.	0 oz.

Malleable Brass.

Copper	56 lb.	0 oz.
Zinc	42 lb.	0 oz.
Iron	2 lb.	0 oz.

Malleable Brass.

Copper	54 lb.	8 oz.
Zinc	41 lb.	12 oz.
Lead	3 lb.	12 oz.

Manganese Brass.

Copper	56 lb.	0 oz.
Manganese	24 lb.	0 oz.
Zinc	20 lb.	0 oz.

Naval Brass No. 1.

Copper	70 lb.	0 oz.
Tin	1 lb.	0 oz.
Zinc	29 lb.	0 oz.

Naval Brass No. 2.

Copper	66 lb.	0 oz.
Tin	1 lb.	0 oz.
Zinc	33 lb.	0 oz.

Naval Brass No. 3.

Copper	62 lb.	0 oz.
Tin	1 lb.	0 oz.
Zinc	37 lb.	0 oz.

Tough Brass for Engine Work.

Copper	77 lb.	0 oz.
Tin	11 lb.	8 oz.
Zinc	11 lb.	8 oz.

Tough Brass for Heavy Bearings.

Copper	84 lb.	8 oz.
Tin	13 lb.	0 oz.
Zinc	2 lb.	8 oz.

Turning Yellow Brass No. 1.

Copper	65 lb.	6 oz.
Zinc	32 lb.	10 oz.
Lead	2 lb.	0 oz.

Turning Yellow Brass No. 2.

Copper	66 lb.	10 oz.
Zinc	33 lb.	6 oz.

White Brass.

Copper	14 lb.	0 oz.
Tin	60 lb.	0 oz.
Zinc	26 lb.	0 oz.

Yellow Brass That Takes a High Polish.

Copper	59 lb.	4 oz.
Zinc	37 lb.	0 oz.
Tin	3 lb.	12 oz.

"AMERLINE" LACQUER.

"Amerline" lacquer is the new product of the American Lacquer Co., Bridgeport, Conn. It is an interesting product from the fact that the manufacturers claim that it is to be the salvation of lacquer-users against corners in fusel oil and the consequent increase in the price of lacquer.

The new lacquer is manufactured without the aid of fusel oil and amyl acetate or any kindred solvent, and for that reason, its domestic source of supply is calculated to give considerable advantage to "Amerline" over the ordinary fusel-oil lacquers.

"Amerline" is a high-grade cotton-dip lacquer for use on all finishes, including silver. It will stand as much thinner as regular lacquer and can be used for spray or dip work with equal facility. On account of its relatively higher boiling point, it takes a few minutes longer to dry hard but when thoroughly dry, tests of abrasion show that it is extremely hard and more durable than ordinary white cotton lacquers. The line of finished samples shown by the company reveal a clear lustrous finish with every sign of perfect adherence. A special advantage claimed by the manufacturing company is that it is not affected by damp or "dog-day" weather and is better in that respect than fusel lacquers. Its odor is different from that of amyl acetate lacquers but it is neither objectionable nor unhealthy. "Amerline" has already been placed in use by

a number of large firms and is reported to fulfill the promises made for it. Full information can be obtained from the Bridgeport company.

A DISCOVERY IN STEEL MAKING.

A Sheffield, England, firm has introduced "Tirth's stainless" steel, which it claims is non-rusting, unstainable, and untarnishable. This steel is especially adapted for table cutlery, as the original polish is maintained after use, even when brought in contact with the most acid foods, and it only requires ordinary washing to cleanse. It is claimed that it retains a keen edge much like that of the best double-sheer steel, and, as the properties claimed are inherent in the steel and are not due to any treatment, knives can readily be sharpened on a "steel" or by using the ordinary cleaning machine or knifeboard. It is expected it will prove a great boon, especially to large users of cutlery, such as hotels, steamships, and restaurants. The price of this steel is about 26 cents per pound for ordinary sizes, which is about double the price of the usual steel for the same purpose. It also costs more to work up, so that the initial cost of articles made from this new discovery, it is estimated, will be about double the present cost, but it is considered that the saving of labor to the customer will more than cover the total cost of the cutlery in the first twelve months.—Commerce Reports.

RECENT DECISION IN SPRAY SUIT.

"The suit brought against the International Spray Co. and John A. Georgio, by Walter J. Smart, trading under the name of the Eureka Pneumatic Spray Co., came up for trial in the Federal Court of the Southern District of New York on December 22, 1914. The patent sued on by Walter J. Smart is one granted to Barton, No. 696,158, dated March 22, 1902, for improvement in atomizing apparatus. The suit was dismissed by Judge Learned Hand for invalidity. The opinion was handed down by the court on December 28, 1914. In consequence, the controversy between the two spray companies has been determined in favor of the International Spray Co., 208 Centre St., New York, N. Y.

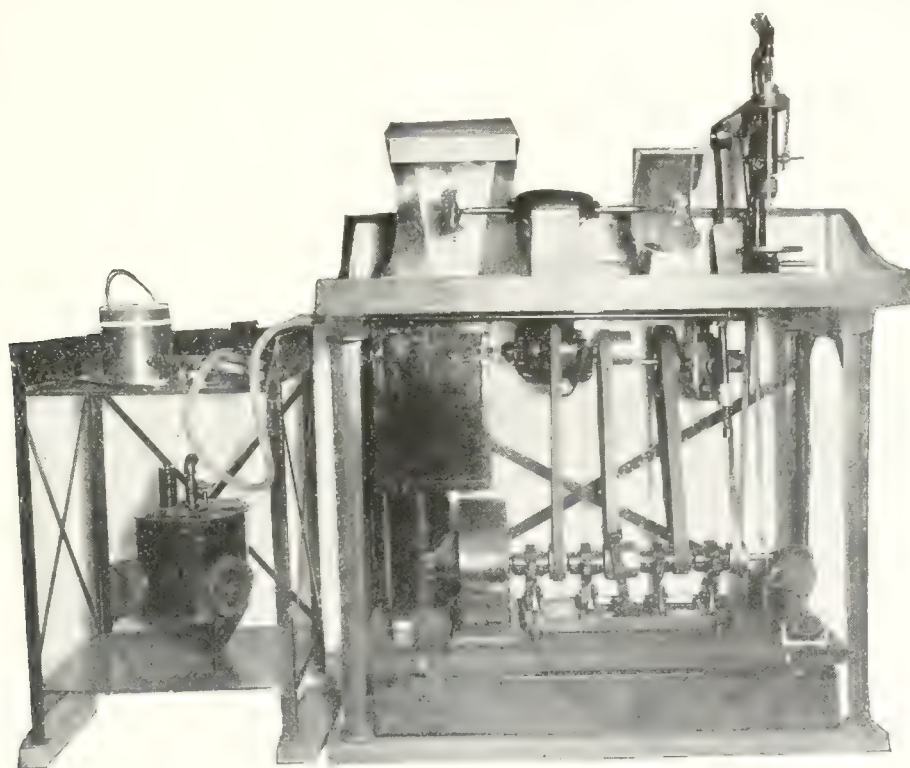
A NEW WORKSHOP BENCH.

Most metalworkers have, at one time or another, felt the need of a small workshop for performing most of the ordinary metal-working operations. Economy of space is necessary, not only with private individuals, but also in the case of the smaller manufacturers and dealers. The illustration given below shows, in a limited way, the possibilities of a new machine, to which the name "The Complete Workshop" has been given by the manufacturers. As will be seen, it occupies a space little greater than that of an ordinary workbench.

possible to retain it and recover its value in new gold or other precious metals.

The drilling machine which is fitted with a high grade chuck, is capable of accommodating a drill from 0 up to 5-16 in. Fastened to the under side of the bench is a pressure blower with the necessary pipe connections running over to the left-hand side of the bench, where arrangements are made to connect the air supply to the furnace as shown on the iron stand along-side the bench, or in its place the sand-blast shown underneath the furnace may be connected and used whenever required.

All of these machines are connected by belts to the shafting shown on the lower platform.



The polishing-dust collecting outfit forms the main part of this machine and is useful and almost essential in the makeup of every metal workshop, especially in shops connected with the ordinary salesroom or retail store. The use of this machine makes it possible to have the stock always looking fresh and bright, and prevents dust and dirt from flying all over the place. When repair work is done and requires buffing, the small particles of precious metals which are removed do not float away through the air, but are drawn in by the powerful suction of air at both of the dust hoods shown in the illustration, and deposited in the tank underneath the bench, to be subsequently recovered and refined. Heretofore this material has been a total loss, but now it is

which in turn is operated by the motor hanging underneath the bench. The motor can be attached to an electric lighting socket, giving ample power to drive either of the individual machines, which can be operated individually. The furnace table is a separate table which can be placed at the side of the polishing machine, or at any other part of the room. In this latter case, it will only be necessary to increase the length of hose to carry the air.

The suction on the dust collecting outfit is so arranged that by an arrangement of dampers, increased suction may be secured at either hood according to the one that is being used. It will be noted that the machine is supplied with a small dust hood on one side, which may be used for small work while the

the other side a larger hood is shown which is utilized when the larger pieces are to be buffed. The polishing head may be fitted with chucks for different purposes, such as sawing, turning, lapping and other operations.

The shaft bearings of the machine are self-lubricating as also are the bearings of the pressure blower and motor. The bench is zinc lined, so that it is easily kept clean and the entire outfit may be operated from an ordinary electric light socket.

This outfit is easily handled and adjusted, it being only necessary to screw the electric light plug into the lamp socket to begin work. The price is reasonable, especially so when one considers what the cost of the various machines comprised in it would be. The makers, Leiman Bros., 62 John St., New York City, have a 20 years' reputation for manufacturing good machinery, and will be pleased to supply additional information and prices to all interested.

FIRE GILDING.

Fire gilding, commonly known as mercurial gilding, is, as its two names clearly indicate, a method of gilding making use of both heat (or fire) and mercury. The oldest form of plating known to us, this process is still in use in cases where a heavy gold deposit is required, and expense is little consideration.

The alchemists, shortly after the discovery of mercury, found that base metals could be coated over by means of what they called amalgams, or the alloys of gold and silver with mercury, and that when the articles thus treated were heated sufficiently, the mercury was driven off, leaving a firm adherent coating of the gold or silver. This is the principle of the process as performed today, though to achieve satisfactory results requires great skill.

The first step in the process consists in the preparation of the amalgam. The gold, pure or alloyed, is rolled into very thin sheet, preferably .0005 in. in thickness. Two parts of pure mercury are taken to one part of gold. The mercury is warmed in a graphite crucible and the gold is introduced in small pieces, and the whole is stirred with an iron rod. The heat must be below red-heat or the mercury will volatilize. The amalgam that forms is poured into cold water, and is soft and easily worked with the fingers, to squeeze out excess mercury.

The next step is the preparation of the article. Only articles that can stand great heat can be treated, and all joints must be hard soldered. A rough surface is given either by means of the sand-blast or by dipping, and every trace of grease and oxide is removed by cleaning. The blue dip used in silver plating is then given, so as to allow the amalgam to spread more evenly over the surface of the article. The dip is as follows:

Water	1 gal.
Cyanide	2 oz.
Chloride of mercury	1 oz.

A momentary immersion is sufficient and the article is ready for receiving the coating of amalgam. This is applied by means of a fine wire scratch-brush, which is freed from grease and coated with mercury by dipping in solution of nitrate of mercury. Every part of the surface of the article must be completely covered, as evenly as possible.

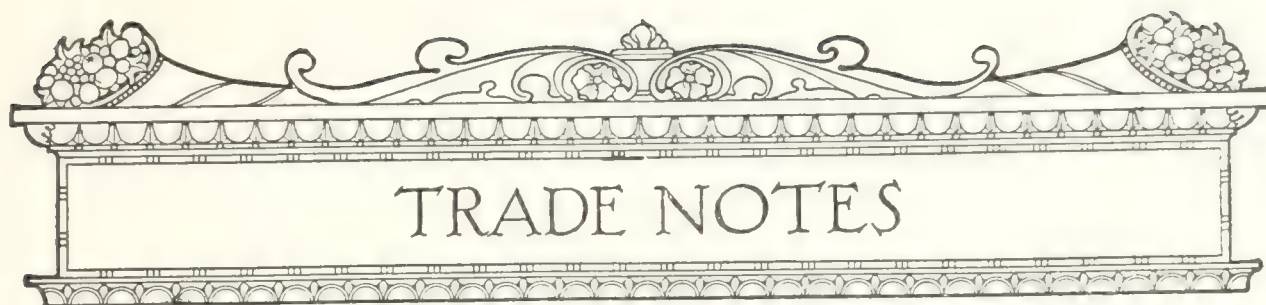
When this is done, the article is ready for "firing", or removing the mercury by heat. A charcoal fire is preferable for this purpose, though an iron plate heated by gas may also be employed.

The article is held by tongs or wire, and slowly, evenly heated, so that the mercury is gradually driven off. It is then plunged into water, scratched-brushed and again heated to remove any mercury spots that remain. It is then dipped into a mixture of 1 gallon of water and 1 quart of muriatic acid, which brightens the surface, giving a dead gold lustre. To give a more completely dead finish, a paste of the following composition is applied:

Saltpetre	8 oz.
Common salt	4 oz.
Mum	4 oz.

This mixture, ground and mixed with water to form a paste is applied to the surface of the article which is then heated till the whole mass fuses. It is then plunged into water which removes the paste.

The advantages of the process consist chiefly in the beauty and durability of the coating, which is much heavier than that obtained by plating. For these reasons it is still much used for buttons and similar articles. The cost, the heat which must be applied and the dangers from mercury fumes, are only a few of the disadvantages which have caused it to be superseded by electroplating methods.



At the annual stockholders' meeting of the Detroit Electric Welder Co., Detroit, Mich., authorization was given to increase the capital stock of the company from \$10,000 to \$25,000.

The George B. Essex Brass Co., 480-484 Franklin St., Detroit, Mich., suffered a severe loss by fire January 22. Damage to the plant and equipment is estimated at about \$20,000.

The Indiana Specialty Mfg. Co., Angola, Ind., has been incorporated by S. C. Wolfe, R. E. Willis and W. W. Love, with \$10,000 capital, to manufacture metal and other specialties.

The Union Metal Mfg. Co., Canton, O., will erect a Canadian factory at Galt, Ont., Canada, next spring, for the manufacture of ornamental posts, etc.

The Western Lamp & Brass Works, 156 W. Lake St., Chicago, Ill., was recently damaged by fire, with a loss of \$75,000.

The West Bend Plating & Mfg. Co., West Bend, Wis., has been established under the management of F. W. Ackerman and Henry Rolfs, at 316 N. Main St.

The Tiffin Art Metal Co., has completed plans for the extensive enlargement of its factory.

The Green Foundry & Furnace Co., Des Moines, Iowa, has a completed draft of plans for a new building to be used for factory and warehouse.

The Whitin Machine Works, manufacturer of cotton machinery, Whitinsville, Mass., is proceeding with an addition to its foundry which will add 50 per cent to the capacity of the department. As soon as business revives the building will be completed and equipped.

The International Smelting & Refining Co., Miami, Ariz., is erecting a copper reduction plant.

The Buckeye Brass & Mfg. Co., Cleveland, O., has taken a large order for bronze bearings for shipment to Canada and to be used in building field provision cars for the English army.

Landers, Frary & Clark, New Britain, Conn., manufacturer of cutlery and hardware specialties, is about to erect a factory for the making and fashioning of celluloid.

The Meriden Iron & Brass Co., Meriden, Conn., has been reorganized with new officers, August Grulich having been elected president.

An electric welding department is to be added to the plant of the Standard Chain Co., Princess St., Pittsburgh, Pa.

The Art Metal Construction Co., Jamestown, N. Y., has been awarded the contract for equipping the new Thomas A. Edison building at East Orange, N. J.

The Bourbon Copper & Brass Works Co., of Cincinnati, O., has secured the contract for supplies for the city of New Boston, O. The material comprises 96 valves of various sizes, an equal number of valve boxes and 44 fire hydrants.

Charles C. Flaesch, chairman of the Industrial board of the New York state department of labor, met with the foundry sanitary code committee recently at the Iroquois Hotel, Buffalo, N. Y., for the purpose of granting a public hearing to brass founders. The committee was named for the purpose of drafting the proposed new foundry sanitary code, determining the provisions as to ventilation, light, safety equipment and general sanitary conditions in all foundries.

The John Davenport Co., Stamford, Conn., manufacturer of piano ware, is establishing a branch plant in Montreal, Canada.

Fire recently damaged the building and some finished goods in the plant of the Art Metal Works at 7 to 15 Mulberry St., Newark, N. J. to the extent of about \$10,000. The fire was discovered in the lacquer department on the second floor, after most of the 200 employees of the firm had gone home.

The Supplee-Biddle Hardware Co., 517 Commerce St., Philadelphia, Pa., has distributed to the trade its New Year bulletin on the use of monel metal. The bulletin shows illustrations of the manufacture of monel metal and also presents photographs of the many applications of this product. To the user of metals, the bulletin will be of interest because it gives a complete list of the varied applications of monel metal in such diverse forms as mosquito netting, fan housing, steam metal, roofing screws, nuts and bolts, wash cords, and wire ropes. Copy of this bulletin can be obtained upon application.

The Enterprise Aluminum Co., Massillon, O., recently incorporated with a capital stock of \$50,000, has established quarters in the galvanizing department of the Massillon Rolling Mill Co., and is engaged in the manufacture of aluminum cooking utensils. It will occupy quarters in the plant of the Amerian Stamping & Enameling Co., when that company's new plant is completed, and eventually expects to build a new plant. The Enterprise Company is closely allied to the other two companies.

W. G. Keller, George Tadich and E. Siple, have formed a joint partnership for the manufacture of brass ingots and castings, refining of zinc and making solder, babbitt and also for the handling of all kinds of metals, old and new. The company, known as the Sandoval Brass Works, Sandoval, Ill., has a plant 200 x 300 ft., almost ready for occupation and expects to commence business February first. Mr. Keller has for the past four years been employed as superintendent of the brass department of the Illinois Smelting & Refining Co., at their Sandoval plant. Mr. Tadich has been an employee of the Mineral Spring Zinc Co.

TELEGRAPHING FOR BURNISHING BARRELS.

Telegrams for burnishing barrels to be sent by express is unusual, but has been the pleasurable experience of the Abbott Ball Co., Hartford, Conn. Readers may have noted that Canada is also at war and electroplaters on that side of the American fence are confronted with finishing problems for saddlery hardware, buckles, uniform buttons, etc. Satisfaction is, of course, expressed in such hurry-up repeat order and the Abbott Ball Co. is also encouraged by similar industrial demands for its products from our United States plateds.

INANIMATE FRIENDSHIP.

"Friends are not necessarily animate!" So says C. H. Ney of the J. M. Ney Co., Hartford, Conn., in a recent original folder entitled "The Dependable Friend of Retail Jewelers". He cites the inanimate friendship of a floating lifebelt to the sinking Titanic passenger, and a written order signed by Huerta for the saving of Dr. Ryan's life. The friendship of good books, good materials, good tools are constantly proving valuable. Ney's business is to prove to the users of solders everywhere the friendship of Ney solders.

This he does very cleverly, not only in the folder referred to above, but in a special message to all workers in metal products in which he describes the history of soldering since 1912, the foundations laid for the perfect soldering work of today and the distinctions between solders as they are and as they should be. It is unnecessary to emphasize the fact that the arguments advanced prove that Ney's solders are what they should be.

There is nothing so helpful to the practical man as the reading of good advertising matter concerning the departments of the work in which he is engaged. The latest literature issued by the J. M. Ney Co., is bristling with good points and should be read by all users of solder and filed away for continuous reference. Copy of this literature can be obtained upon request. We repeat "Friends are not necessarily animate". Ney! Ney!

The Brass World & Platers' Guide

BRIDGEPORT



CONNECTICUT

VOL. XI.

MARCH, 1915.

No. 3.

A Monthly Journal Devoted to the
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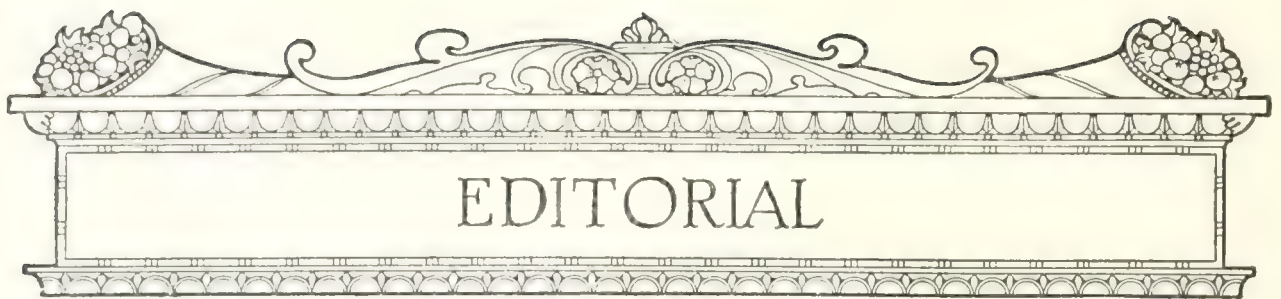
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BUY IT NOW.

The progress of an industry has never been due to **SAVED MONEY**.

The Spirit of Purchase is the Spirit of Progress.

MONEY by itself can not purchase anything. It is worth less than wheat for it cannot be eaten. It is junk compared with water for it cannot slake thirst. Its value in comparison with air is zero minus. All the gold of the Incas could not take the place of air in an ordinary living room to sustain the life of its inhabitants for five minutes.

Money is merely the focalization of human endeavor and aspiration in visible and portable form. It is the herald of things accomplished and the harbinger of deeds to be. It is a credit alloy of the work of the past and the hope of the future by means of which the character-casting of the present may be successfully accomplished.

Money Must Be Spent in Order That Business May Be Created and Carried On.

To **SPEND** money requires brains, energy, judgment, selective care, wise discrimination, foresight and single-mindedness. People with cold feet never **SPEND** money. It is torn from them by force or they let it ooze from them in atomic dribblets with great pain.

The future of our business does not depend on the money we may save now. We are on the threshold of an era of commercial activity unprecedented in the world's history. Our present liabilities are mostly heritages of the foolishness of the past. We may easily free ourselves from them by the wisdom and courage of our actions in the future. Who shall doubt that good fortune awaits us by embarking on a voyage of well-defined effort **NOW**? We have dragged and swung with the tide long enough. It is for us to trip the anchor and leave the shoals of Uncertainty and Indecision.

Were you contemplating the purchase of

new foundry supplies? Don't hesitate—**BUY THEM NOW.**

What did you figure the other day as to the manufacturing economy to be gained by the purchase of a pyrometer or a new type of furnace or molding machine? You were certain about it. **BUY THEM NOW.**

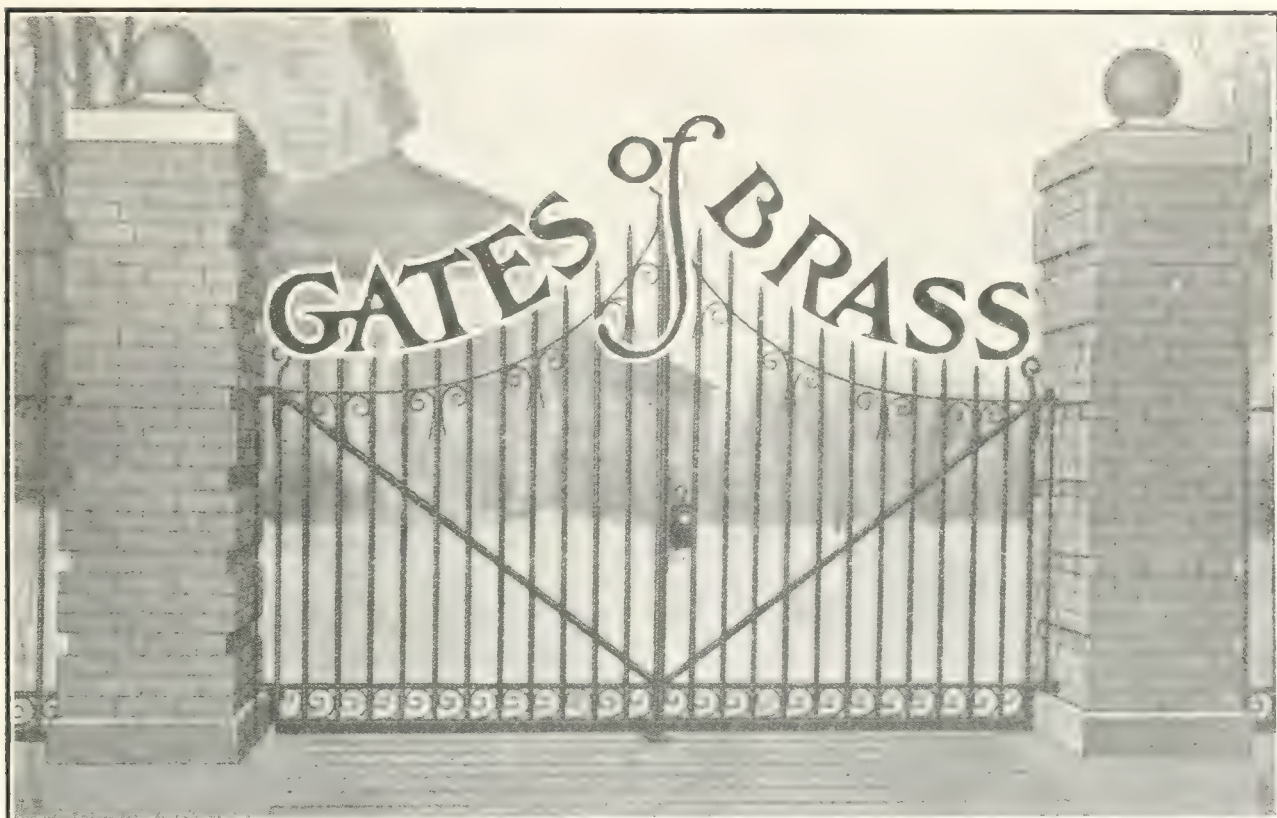
How about supplies for the plating room? Have you been promising to install voltmeters, ammeters, additional water supply, exhaust fans, better lighting conveniences, plating or burnishing barrels or test out the merits of different chemical supplies for your particular line of work? **BUY THEM NOW.**

Don't Attempt to Govern Your Business Policy for April, May, June, July, August, September, October, November and December by the Headlines in the Morning Papers for March 17th.

The headlines on August 1st made us figure on substituting the office boy for our book-keeper, so bad were our chances. We are still alive and doing business. Thousands of other headlines since then have captured our nickels and frozen our commercial marrow momentarily. Nevertheless, we are still alive and the snow is disappearing and the geese are going north and the bluebirds have appeared and the sun is shining.

The leading railroads of the country have ordered over \$15,000,000 worth of rails, structural steel, freight cars and engines.

These steel rails, freight cars, engines and bridge materials have not been bought for the museum of natural history or to decorate the landscape with. Railroads are built to earn money by moving people and goods. Goods have to be made to be moved. With our present low stocks, the railroads could move all we have on hand with half their 1914 equipment. **THEY KNOW THE GOODS WILL BE MADE FOR THE MOVING.** You and your customers have to make these goods whether you have the orders yet or not. What you need to make the best goods at least cost and with greatest economy—**BUY IT NOW.**



By RUSSELL R. CLARKE.

"Back of every effect there is some cause; interwoven with every act, some science * * * Basic knowledge differentiates the craftsmen of every trade. It marks the difference between the self-reliant man and the automaton; between the productive and reproductive types of workmen and workmanship."

We have heard them sing of the pearly gates, and the golden gates and the gates that stand ajar. We have read of the iron gate, and the city's gate and the flame-licked gates below. We have passed through the wicket gate and stood at the garden gate and moved at a rapid gait when ominous sounds of the night disturbed the ambient air. But of all the gates that gate-makers make, there are none with which we are more familiar than those we have elected to our consideration in this article—the Gates of Brass—those interesting holes and channels in skill-shapen sand, through whose straight or winding course a limpid, molten mass is directed to its tenement of clay, there to cool to the blackness of ruin or a merchantable casting.

In this applied sense, the term would appear to trace its origin to that universal tendency of the human mind to compare objects with respect to their points of agreement and

disagreement; their similarities and differences. It is, therefore, largely the product of suggestiveness. Many applied terms springing from this source indicate far-fetched comparisons or reveal similarities in certain particulars only, wherefore names thus derived and applied must often be placed in the category of broad or indefinite terms.

From a molder's view-point, this is the status of the word "gate." It is a broad, general term, used to indicate part, parcel and whole of the openings in pattern-impressed sand through which molten metal courses into a mold or flows through and in part back out of it again; the latter to overcome the operation of some natural principle, whose effect unrestrained would be adverse to good casting quality. The word "gate" is largely used to denote both component parts and whole. In written discussions and in some foundries, the custom sometimes is to refer to the parts by different designating terms, such as sprue, riser, head, etc., though this is the exception rather than the rule and indicates merely associated features of the general idea.

In our succeeding statements we shall stick to the general term using qualifying words to designate the different kinds, as pressure gate

or head, pouring gate, connecting gate, delivery gate, skim gate, horn gate, etc. The accompanying diagram will illustrate each particular kind.

The importance of gate relation to casting quality admits no question of doubt. We find it evidenced in the foundry almost every day. During three years' experience as brass and bronze casting inspector, we found that at least 30 per cent of all rejected castings owed their defective condition to improper gating. In this connection we can verify a foundry experience which still further substantiates the contention of gate importance. A great number of castings had been ordered under specifications covering a high-pressure test. The patterns were mounted on plates with the view of making the molds by machine. The very best metal was used but gave only casting failure under test. The formula was then changed and varied time and again with no better results in evidence. Finally it was decided to go back to the original formula and alter the method of gating. To accomplish this the patterns had to be taken off the plates and re-arranged. The execution entailed considerable expense and trouble but a minimum of further casting failure under severe test substantiated the wisdom of the change and amply repaid for all the disadvantages encountered in realizing it.

How to gate, where to gate and why are questions of most prominent significance in a brass foundry. As the connecting link between metal in a crucible or a pouring ladle, and metal in a mold; between high temperature metal in its liquid and metal in its cooling or solid state—it is at once apparent that a brass gate is something more than a mere channel or medium of transmission; that properly designed and judiciously placed, it is not a haphazard affair but rather a scientific creation, calling forth the most critical thought and skill of the craftsman.

Molten metal is a liquid and as such possesses the properties and obeys the laws and principles governing the actions of a liquid. It is a solid robbed of its solidity, a consequence of heat, subject to every physical change which extremes of temperature are calculated to produce on metallic substances. With any advance in that temperature, its tendency is to enlarge in volume, passing from a solid to a liquid, from a liquid to a gas. With reduction in temperature, it diminishes

in volume and finally reverts to a solid, manifesting all the evidences and consequences of heat supplied and then withdrawn. From solid to liquid, from liquid to solid, metallic substances are in the reign of uncompromising law, 'neath the sway of its despotism. It is not in the furnace, nor the crucible, nor even the cavity of pattern impression in sand, it is given us to arraign law against law and principle against principle but rather in these often neglected channels which the molder calls his gates.

The first out-of-the-ordinary feature of a brass gate is the fact that it can be successfully applied to its purpose in green sand. It is wonderful that a body of tamped earth, held together only by a cohesion superinduced by the most common of all liquids—water, in itself cohesively weak, will tolerate a high-temperature liquid striking it with great force and rushing through and over it, developing strong vapor pressure all along its route, without disintegrating and joining the onrushing current. Such a thing is impossible with water, or oil, or melted wax; then how so with molten metal? An explanation is that the extreme heat of the metal glazes the surface of the gate and compels the ordinarily inertly-cohesive properties of the sand to the exercising of their functions. The gate of almost any short-poured mold will furnish a good illustration. An examination of the surface sand will disclose a hard, baked crust, extending from one-quarter to one-half an inch inward and terminating at the moisture line of the green sand beneath. This moisture line is also a parting line by virtue of which the baked crust is easily loosened and easily displaced. It is therefore nothing more than a common-sense proposition that all rippling of the metal or other unnecessary commotion in the gate should be reduced to a minimum, smooth and uniform surfaced gates being contributing factors of consequence. Dancing water in a mountain stream is alright, but rippling metal in a gate is a different proposition. To realize further efficiency in gates employed for heavy castings, a deposit of good plumbago well rubbed into the sand of the gate will be found valuable.

In order of position, the first gate native to a brass casting is the head or pressure gate. This is in part an added gate, yielding advantages in the pouring of heavy castings, and also for castings which extend far up into the

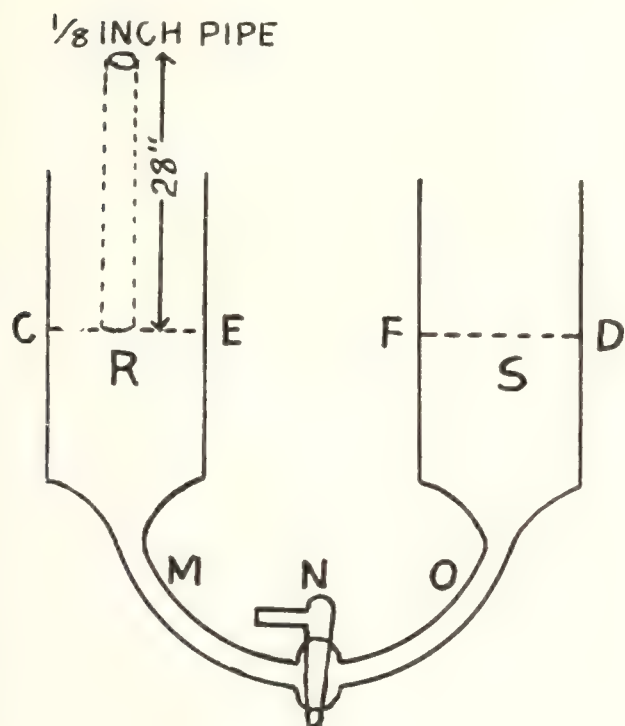
sand of the cope part of the flask. It is really an extension upwards of the pouring gate and can be considered a part thereof. Its usefulness is fundamentally derived from three important properties common to all liquids. These properties are:

1. Liquids passing from one medium of confinement to another through a closed connecting channel will come to rest at a common level and have their surfaces in the same horizontal plane. In its various forms, the fact finds expression in the statement that liquids seek their level.

2. Liquids transmit pressure undiminished and in all directions.

3. Liquids are practically incompressible.

To better confirm our understanding of these principles and more clearly establish their identity in a brass gate, let us illustrate:



Suppose R and S to be two equal cylindrical vessels with their bases connected by the tube MNO having a valve at point N.

Suppose the valve to be closed and R to be filled with water.

By opening the valve, the water will drop to a point C in R and rise to point F in S, while the liquid surfaces C-E and F-D will lie in the same horizontal plane. By using a liquid heavier than water in R and one lighter than water in S, the liquid surface will drop in R and rise in S in proportion to the specific

gravity of the two liquids, thus indicating that the whole process is merely a balancing of weights.

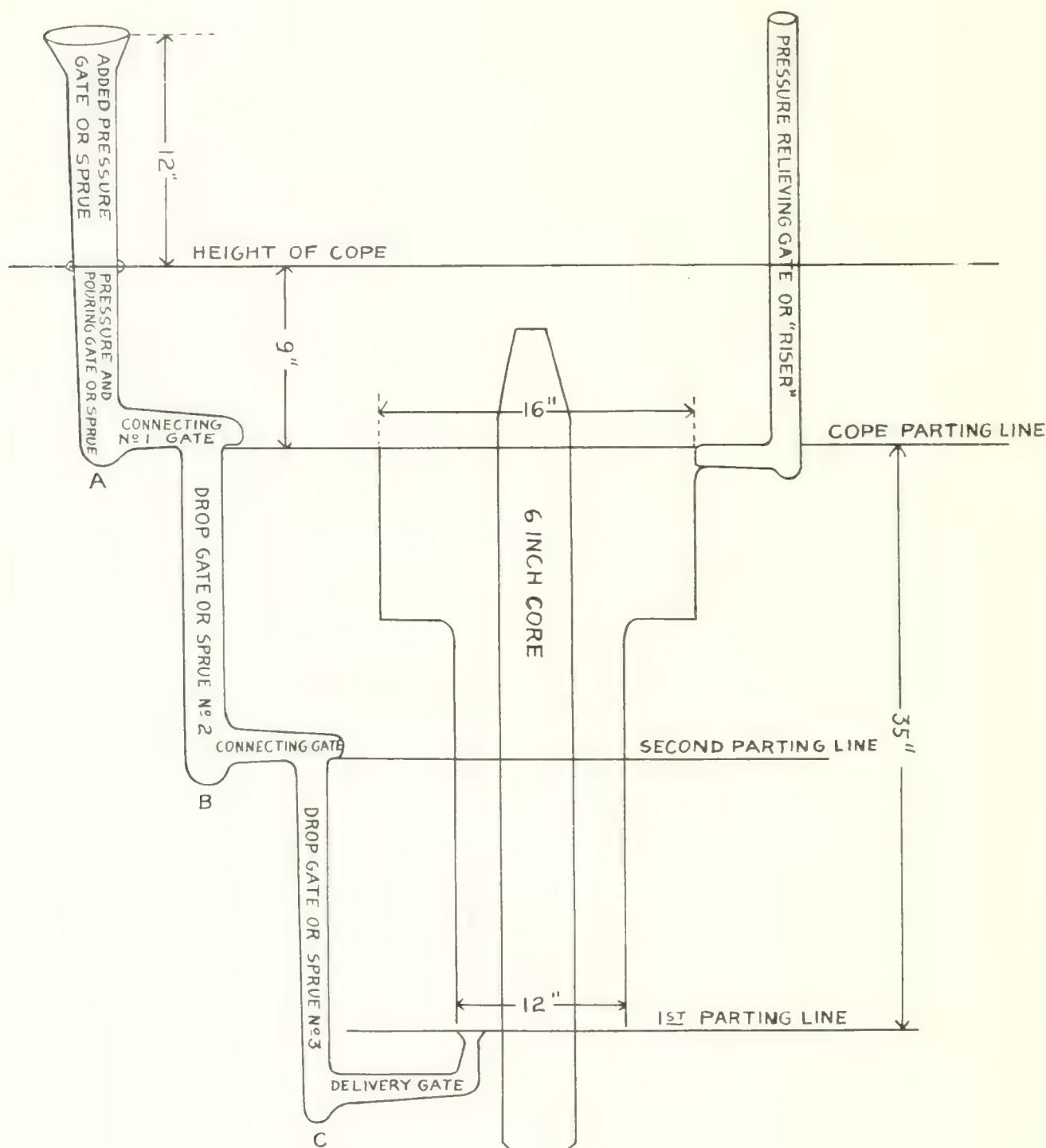
Next, rigidly attach neat fitting discs over surfaces CE and FD, excluding escape of water and air under pressure. Insert a pipe in disc covering surface CE, said pipe to be $1\frac{1}{8}$ in. inside diameter by 28 in. long. Pump air into this pipe to one pound per sq. in. pressure. We will then find that the liquid surface CE gives no evidence whatever of deserting its relative position, while on every square inch of FD surface will be exerted this same 1-pound-per-sq.-in. pressure, it being understood that pressure on CE is pneumatic and that on FD hydraulic. From this, we can conclude that water and liquids in general possess the properties of incompressibility, and that they invariably, as stated, transmit pressure undiminished in all directions, it being necessary only to examine sides and bottom of the vessel to find this same 1 pound-per-sq.-in. added pressure. Now if instead of pumping air into this pipe, we open the upper end and fill the pipe with pure water, we will find that on disc covering surface FD exists the same pressure as when we pumped air into the pipe. (It may be convenient to remember that a $1\frac{1}{8}$ in. pipe has an open end surface area of nearly 1 square inch and one 28 inches long will enclose about 28 cubic inches of space and hold approximately 1 pound of water.)

If now instead of water as the liquid, molten brass is used, the pressure per square inch will be increased from 1 to $8\frac{1}{2}$ pounds. Assuming the cylinder to be 8 inches in diameter, the combined water pressure on each of the two discs would be close to 50 pounds and the combined metal pressure about 425 pounds. Assuming it to be 16 inches in diameter, it would be four times these respective figures or 200 pounds water pressure; 1700 pounds metal pressure. This explains why it is harder to keep a cope from raising over a casting 24 inches in diameter and weighing approximately 60 pounds, than it is to prevent a cope strain over a solid stick 8 inches in diameter and weighing 400 pounds. It is the letter of the law that the liquid transmits the pressure to each and every square inch of surface with which it comes in contact so that equal areas of top, sides, bottom and all parts of the vessel are equally affected there-

by*. To avoid confusion it might be well to state that these figures are derived in disregard of atmospheric pressure and are submitted merely in illustration of the principle.

employed, is a duplicate of the hydrostatic paradox.

As already indicated, perfectly molten metal is a liquid. Having passed that degree of temperature where the last trace of solidity dis-



A mold with its gates and resorting to molten metal instead of water as the liquid

*This principle is responsible for what is known in natural philosophy as the "hydrostatic paradox", something that is unreasonable but anyhow, is, apparently false yet nevertheless true..

appears through dissolution, its properties as a solid are either seriously impaired or completely destroyed. Expansion and contraction have lost of their power, cohesion has relaxed its grip and repulsion strengthened its arm. As the liquid mass reverts to a solid, however, it gradually comes into its own again. Expansion and contraction reassert themselves, pressure

transmission weakens, cohesion strengthens and repulsion diminishes. It is therefore evident that there are different degrees of metal liquidity—that at their most advantageous pouring temperature, different alloys for different castings are not perfect liquids and in consequence refuse to obey to the letter the laws and principles involved. To force them to this obedience in the face of every adverse influence is the function of the pressure gate. In resorting to its use, it is important for the molder to know that its effect is derived primarily from height and not from volume. With every 3 inches added in a $1\frac{1}{8}$ inch diameter gate the pressure increases 1 pound per square inch. It is possible to attain a height that will strain the most substantial mold, and force the metal through the cores into their vents and that between the evils of high and low extremes, to locate the happy medium is part of his craftsman task.

To arrive at a clear conception of the actions of metal entering a mold through its gates, discover the identity and application of important principles already noted and tangent thereto, to study also the value of design, execution and function of these gates as affecting quality, as well as the importance of their relation to each other, let us consider them in connection with the illustration, Fig. 2.

This represents a large, blank pinion gear, 35 in. long, 16 in. in diameter at the gear wheel end, weighing close to 1200 lb. and standing in molding position. Assuming the metal to be of copper base and sufficiently high in temperature to insure practical liquidity, let us conceive it as entering the funnel-shaped top of the added pressure-gate and dropping through the pressure and pouring gate to the terminus of this gate in button "A". This funnel-shaped top is of prime consideration and merits special constructive care. When properly formed it goes far toward reducing the evil of metal slopping in pouring and the attendant loss of high-priced product, both of which are piercing thorns in either side of any good foundry foreman. Moreover it is often responsible for a dirty casting. It frequently happens when the ought-to-be cone spreads out to basin bottom contour or the line of union between the straight and sloping walls of the gate is sharp, that the force of the falling metal displaces the sand in these vicinities and carries it into the mold. To intercept this trouble the cone feature should be realized and

the surface of the sand forming it well slicked with plumbago, or talc.

Likewise buttons *a*, *b* and *c*, though often neglected, are quite important. In a liquid, cohesion is woefully weak, consequently any liquid falling on a flat surface will splash and scatter. Molten metal is no exception and in its splashing it is indeed a hard knocker, producing a consequence kindred to that noted in the basin-bottom of the funnel. The difference between dropping it on this flat surface and dropping it in a pool of its own element is quite natural and apparent. In addition to this the sand in button vicinity should be consistently soft, giving a cushion-like effect to the first falling metal. The button is really a shock-absorber and surface-sand protector against the force of gravity acting on a falling body. Jump out of a second story window first on to a hay-stack and then on to a brick pavement and you will perhaps appreciate the value of the button to the gate.

But we must follow the metal. It has risen in the button and is now coursing through the connecting channel to the brink of drop gate or sprue No. 2. For an instant it pauses, then chased by the rising tide behind it goes over and down to button *b*, across the second connecting gate down drop gate No. 3 to button *c* and thence to the delivery gate. There it must tarry and await the reinforcement of following metal.

In this interim let us go back and consider more critically the design of its channels. You may notice that the pressure, pouring and drop gates are all slightly cone-shaped, diminishing downward and that the mean diameter of each succeeding gate is slightly less than the one preceding it. You may also notice that per linear inch the average volume of the connecting gate is less than that of its preceding and about equal to that of its succeeding drop gate. It is a feature to be observed also that these connecting gates are cut in the main above the parting line; they are slightly inclined upward at their bottoms and diminish in volume from source to mouth, this being of special note and importance in the delivery gate. The object of it all is to retard the progress of the liquid mass as it descends the steps to the mold's bottom entrance and make it dependent on a rise of metal in the gate preceding for continuation of its progress. In other words, by mechanical construction we aim to slightly retard the

metal's immediate tendency to rise to the level of the gate in the mold. By so doing we set a trap in the connecting gates, back the metal up in the drop gates and catch and confine much of the oxide, dirt and dross in these gates, impurities which would otherwise be borne rapidly through them and into the mold.

That this cone-shaped feature would appear to create suction is a matter of small consequence in view of the marked difference in specific gravity between the dirt and the liquid mass. With water it would no doubt be a factor of consequence; with metal, however, it is of little concern.

So we find the metal at the mouth of the delivery gate consistently clean and clear. It is there at its lowest point, 56 in. beneath its source. Having dropped rapidly down and entered a more spacious chamber it must rise slowly back again. Here it meets new and opposing forces; gases and vapors press down on its surface; gravity turns its hand against it. The metal chills and becomes sluggish, cohesion slackens and added friction diminishes its progress. In spite of all, respondent to the last call of its own liquid nature and driven by the pressure gate, it will rise higher and higher, nor come to rest until liquid surfaces in its source and its terminus lie in the same horizontal plane.

Then the pressure exerted is one pound per square inch for every 3 inches of height that the pressure gate,—absolutely regardless of its diameter, volume, or shape—rises above the top surface of the mold and the sum total of the pressure on this top surface equals this unit of pressure multiplied by the number of square inches in the surface area. In the instance under illustration this top surface contains 173 sq. in., the height of the pressure gate is 21 in., the pressure per square inch is approximately 7 lb. and the sum total of pounds pressure is 1211 lb. The gate we would select in this instance would be $2\frac{1}{4}$ in. in mean diameter but the pressure exerted would be the same were it $\frac{1}{2}$ -in., 1 in., 10 in., or any diameter so long as not too small to permit free transmission of consistently liquid metal.

And this is the paradox, the thing beyond belief, yet a scientific fact in practice practically approximated. Nor is this all of its interesting features. The law reads "undiminished in all directions" and applies to bottom and sides of the mold as well as top. Following out the effect of the principle's application, the gate

pressure in pounds on square inch of bottom or side surface equals one-third the perpendicular height that the top of the gate lies above that point and the combined pressure on any section of these surfaces equals the area in square inches of that section multiplied by the pounds pressure per square inch. In consequence the gate pressure per square inch on the bottom of our mold is 18 2-3 lb., at its middle point 12 4-5 lb. The combined gate pressure on the bottom surface is 1608 lb., on a cylindrical surface one inch wide at the bottom, 704 lb., on the same at the middle point, 483 lb. Such is the effect of the pressure gate on the mold. It bears important relation to the other gates also; these we will note in their turn. In the meantime we call attention to the advantage of observing the principle of "pressure from height." Molders should be required to observe this principle, doing away with 3, 4 and 5 in. head sprues and the idea that their added weight gives added pressure. By so doing they will gain in number of molds poured and evade the loss of remelting much gate metal without purpose.

To evaluate the pressure per sq. in. which any metal exerts in any vicinity of the mold, divide the height by which the top of the gate exceeds that vicinity by 28 and multiply by the specific gravity of the metal.

The specific gravity of copper is from 8.6 to 8.9; of brass from 7.6 to 8.8; of iron from 7 to 7.3; lead 11.5; tin, 7.3.

(To be continued)

INTERESTING TO BRASS FOUNDERS.

Forty-eight pages, containing 69 illustrations of foundry apparatus, full of valuable data on their construction and service, terminating with the characteristic signature of the man responsible for the planning and execution—these represent the new "Brass Foundry Equipment Bulletin", issued by Frederic B. Stevens, Detroit, Mich. It bears the more specific title "Melting Furnaces and Complete Foundry Installations." Natural draft crucible furnaces are given first consideration as effective metal melting is of chief importance to all founders. All other accessories to economical operation are then dealt with. This new technical bulletin can be secured free of cost upon application to its author—Frederic B. Stevens.

THE BEGINNING OF THE LACQUER INDUSTRY.

When the universe was a-building, the Great First Person laid down a solid mass as foundation for all future efforts at self-expression.

Air was then given for the sustenance of life and water to facilitate travel and for universal purification.

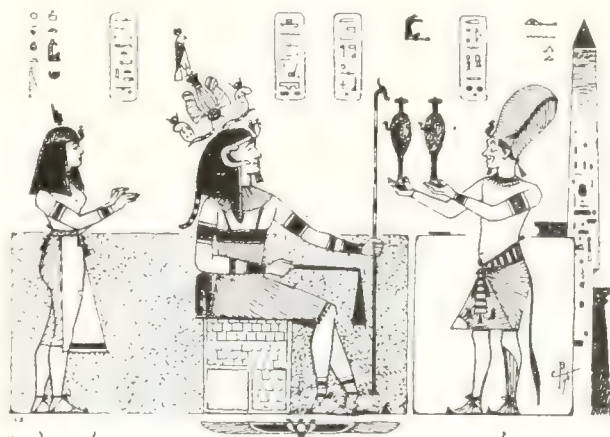
The earth He clothed with foliages diverse—grass, shrubs, plants, trees—each with a special function in the work of maintenance and perpetuation of the universal structure.

The Vegetable Kingdom was chief among the orders of creation and the rulers thereof—the oak, the chestnut, the pine, the poplar, the fir—rejoiced at their supremacy and were content to give of their abundance to the birds, the beasts and men in exchange for some measure of protection from insects and the demon called Fire, who came sometimes at men's bidding and at other times of his own accord and often proved unmanageable and destructive.

Then men found metals for service and adornment and in the glories of construction and destruction gave the metals first honors, Steel being king and Gold the world's treasurer.

Long intervals of peace gave opportunity for the study of art and decoration and the metals pressed into service disappointed their users, for they tarnished readily and Air laughed, for men had forgotten how powerful he was. Then men in perplexity turned to their old allies for advice and the shrubs and the trees told them "Hast thou been so long time with us and thou hast not known us. O Man? What sustains us against the forces of the air—the frost, the snow, the tempest, the rain, the heat? What gives us our elasticity, our ability to shed moisture, and preserve our freshness from year to year but the sap that flows in our veins?"

Men saw the light then and the vegetable mouse saved the metallic lion from the toils of the air. The life-juices of all plants, shrubs and trees were tested and the lacquer trade began. Previous to this time resins and gums had served in religious rites before the altars of thousands of deities worshipped by men, for in the beginning God made man in his own image and man has been repaying Him the compliment ever since.



"ON THE FIRST DAY OF 'YAG' . . . ATHOR CAME TO . . . RAMSES WITH AN OFFERING OF PRECIOUS LACQUER . . ."

Paying Lacquer as Tribute.

Making lacquers was a special business in the early plating days and the plater knew nothing of it. Every department of the work was a specialty then. The rouge buffer was an artist in his own line and knew nothing else and did not want to know. The growth of lacquer usage, the increasing excellence of manufactured varnishes and the discovery of cotton lacquers, brought about a revolution in the duties of the plater, then becoming an electro-plater.

During this transition period, many platers made their own lacquers and their mixtures were sometimes as mysterious and complex in lacquers as in solutions.

HISTORY OF CELLULOSE LACQUERS.

By E. N. TODD.*

The discovery of the Cellulose Nitrates is generally credited to Schonbein, who predicted, in 1845, that they would be used as a substitute for gunpowder.

All the early investigations in this important field were confined to the manufacture of the explosive forms of nitro-cellulose to be used as a substitute for other materials used in

Edward Chauncey Worden, in his valuable work "The Nitro Cellulose Industry", makes the statement, that the phenomenal expansion of Cellulose Nitrates in their industrial application is due to the extension of the number and influence of solvents.

During a period of 37 years the solvents discovered were many but all were particularly applicable to the manufacture of solid compounds, known as "Parkesine", "Celluloid", "Zylonite", etc., and the introduction of these materials marked an era in the art. This brief history of the liquid compounds dates from 1882, as that is the date of the issuance of the first patent relating to non-hygroscopic solvents and diluents of pyroxyline, suitable for solutions, and marks the date of the beginning of a new era in the development of the art.

It is interesting to note the development over a period of seventy years from warfare to surgery, to novelties, to photography, to warfare.

Previous to 1882, Collodion, a solution of Nitro-Cellulose in ether and alcohol, was employed in surgery and to some extent in the arts, for transfer work and as a protective coating; but, owing to the fact that the solvent was very volatile and that under ordinary atmospheric conditions the resulting film was brittle and opaque, it was found impracticable to use collodion as a protecting medium for purposes where spirit, varnish or lacquers had been or could be employed.

The lacquer in general use, previous to 1882, was a solution of shellac in alcohol, which required considerable skill for its application and a high degree of heat for hardening, resulting in a coating, not transparent, but opaque and having a yellow or golden tint. Scientific instruments, brass beadsteads and some of the more expensive metal ornaments such as mirror frames, toilet sets, etc., were lacquered with shellac, but this lacquer was used more as a finish than for the preservation of the metal.

The manufacturer of chandeliers, builders' hardware, etc., used at this time practically no lacquer and depended mainly upon oxidizing agents, enamels and japans to produce their finishes. Who cannot recall the green or verd-antique gas fixture, the black japanned



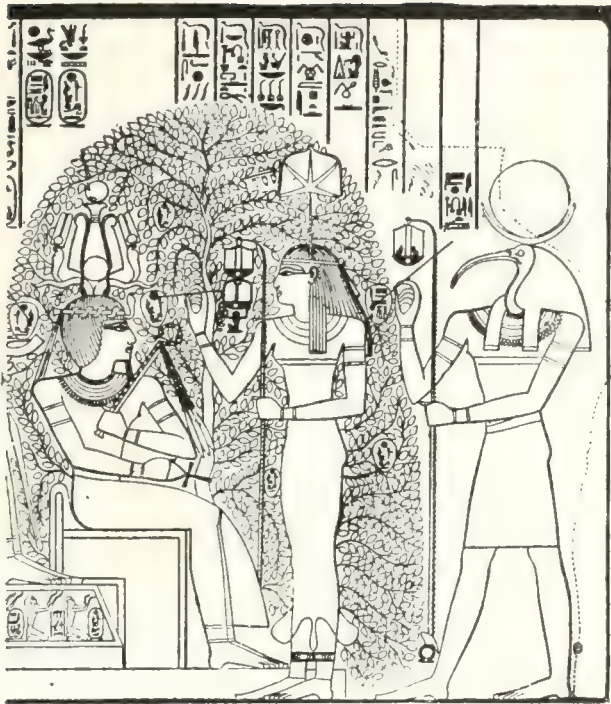
Mandeville's Idea of Cotton.

In the middle ages cotton was known in Europe only by report and by the name of "vegetable lamb." Explorers, of whom Mandeville was the chief geographical liar, described it as "A plant resembling a lamb, attaining the height of 2½ ft. with head, eyes and ears and all other parts of the body as a new born lamb. It has a soft wool and is rooted by stem in the middle of the body, devouring the surrounding herbage and grass. When this supply of food was exhausted, the animal died and the wool was gathered. Men eat both the fruit and the beast and that is a great marvel. Of that fruit I have taken also. It were wonderful but that I know God is marvelous in all his works." The illustration is Mandeville's.

warfare, and it is probably owing to this fact, that the idea prevails that the cellulose used in surgery, lacquers and photography is the explosive form, but such is not the case.

The explosive material (commonly referred to as gun-cotton) is not soluble in any of the solvents used in the arts and manufactures and therefore gun-cotton cannot properly enter into the manufacture of any of the solutions referred to in this article.

*Vice-President of the Hanson & Van Winkle Co., Newark, N. J.

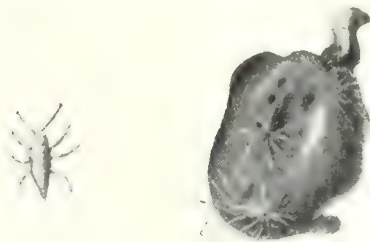


King Psametik, on the eve of his Marriage to "Rhodopis," of Naucratis, Causes the Gold and Silver Decorations of his Throne to be Treated with Precious Lacquer Lacquer on the Throne.



Winged Male in July. Magnified 6 Times.

Wingless Male in February. Magnified 20 Times.

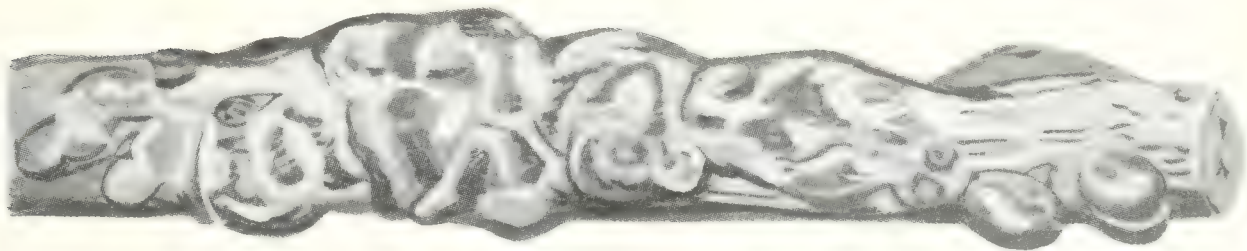


Young Female. Magnified 10 Times.

Dead Female, Young Emerging. Twice Natural Size.



Hair-Raising Attempt to Get a Good Lacquer Brush in Early Times.



Stick Lac—Natural Size.

These Indian insects, called "Tachardia Lacca," produce the lac from which shellac is made. Their span of life is six months. Twice a year the young swarm. They affix themselves gregariously to the neighboring twigs, the bark of which they pierce with their beaks. They suck the sap, giving it out again as an excretion, which solidifies on contact with the air and gradually forms about their bodies a scale called "Lac". This scale protects them from enemies. Each female produces a family of about 1000 (5 per cent of which are males) and gives her life with it. In about June and November the encrusted twigs are broken from the trees by the natives. These are called sticklac (see illustration) from which, by a process of crushing, separating, cleansing, melting of the lac into flakes, etc., the natives produce shellac, button lac, tongue lac, and garnet lac. Calcutta is practically the only distributing port for the world.

We acknowledge with thanks the assistance we have received from the leading members of the lacquer trade for the data and illustrations furnished for this article, special tribute being given to representatives of Hanson & Van Winkle Co., the Egyptian Lacquer Co., Celluloid Zapon Co., General Bakelite Co., Maas & Wald-

stein Co., International Smokeless Powder & Chemical Co., Damard Lacquer Co., Albany Chemical Co., Frederic B. Stevens, and Franklin H. Kalbfleisch Co. The interesting photographs of the lacquer insect and the stick lac are published through the courtesy of the Rogers-Pyatt Shellac Co., New York City.

hinges and padlocks and the glass and wooden door knobs?

After the articles were burnished or polished the manufacturers and consumers depended upon continual repolishing or "elbow grease" for preserving the finish.

Bronze, owing to the fact that it remained bright or polished longer than brass and copper, was in great favor for the more expensive classes of builders' hardware, where the original cost and the cost of maintenance was not considered of primary importance. Keeping the brass, silver and other metal articles clean in the household was one of the chief cares of the housewife.

The growth of the nickel plating industry was the beginning of a demand for bright and polished metal articles. Nickel being hard, taking a high finish and oxidizing slowly, grew to be largely used as a coating where a high finish was desired and for a considerable period "NICKEL PLATED" was an expression used to convey the idea of the brightest and the best.

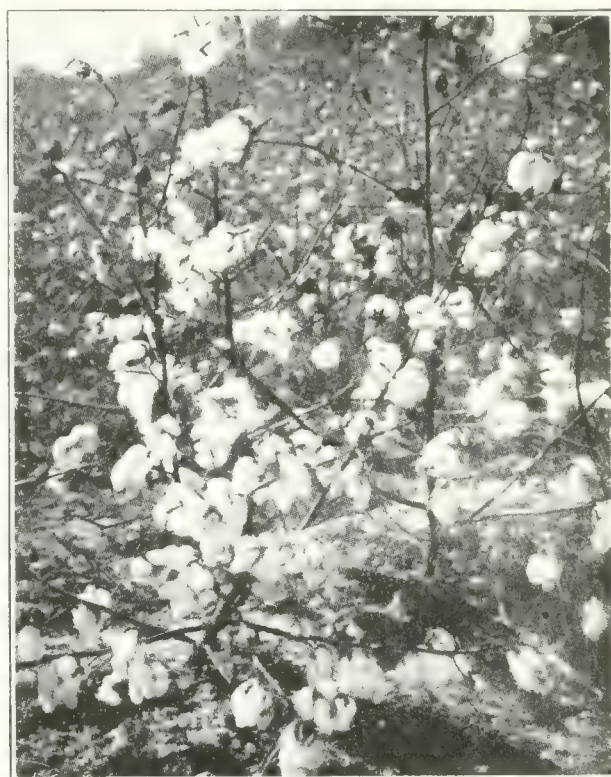
The introduction of steel, which owing to its great strength and small cost was used to replace the more precious metals, created a demand for deposits or finishes of silver, brass, copper, nickel, etc., which greatly stimulated the electroplating industry and created a demand for some medium, impervious to water, and not affected by acids and alkalis, which would protect the polished article from oxidation and at the same time preserve the color and finish. This situation led the Hanson & Van Winkle Co. to make experiments having as their object the production of transparent lacquer, some time before the manufacturers of metal articles recognized the situation.

A transparent coating was the logical demand and a transparent coating was the logical result.

It would require a metaphysician or a psychologist to define the relation of the hour to the man, but the hour had arrived and John Stevens was the man who solved the problem. During the period above referred to, John H. Stevens of Newark, N. J., working along entirely different lines and probably unacquainted with the particular demand, in a series of original investigations, discovered and patented in 1882 a group of solvents and diluents of nitro-cellulose. Mr. Stevens has testified that he added a fixed quantity of nitro-cellulose to every material he came in contact with, and

after letting a mixture stand a given time he presumed that the materials which dissolved nitro-cellulose were solvents and so claimed in his patent.

In his patents he first disclosed to the world the non-hygroscopic solvents of nitro-cellulose, having a comparatively high boiling point and of medium volatility.



King Cotton at Home.

Cellulose is the skeleton of vegetable organisms and is found in cotton in its purest form. Cotton contains from 88 to 92 per cent cellulose, 6 to 8 per cent water and the balance wax, protoplasm and ash. The discovery of gun cotton solvents gave us celluloid, the photographic film roll and film pack and cotton lacquers.

Before the patents of "Stevens" disclosed solvents and diluents for the manufacture of lacquer from nitro cellulose the only non-hygroscopic solvent known was nitro-benzole. Some progress had been made in the manufacture and sale of lacquers, employing nitro-benzole as a solvent, but with limited success, owing to the high boiling point and oily nature of this solvent, which made it necessary to use with it a large quantity of more volatile hygroscopic solvents.

Hanson & Van Winkle Company and Richard Hale, both of Newark, N. J., were manufacturing and using nitro-cellulose lacquers at about the date of the Stevens patent, 1882, but the difficulties of application

were so great, owing to the use of solvents miscible with water, that only manufacturers willing to install special equipment and appliances were interested.

In the early eighties the writer was employed by The Hanson & Van Winkle Co. to introduce nitro-cellulose lacquers to a skeptical world.

In looking backward over a period of thirty years the troubles encountered in this quest, which was undertaken over a great portion of the United States and extended to England, France, Belgium and Germany, appear incredible. Manufacturers and workmen were skeptical and ignorant of the theoretical possibilities of a thin transparent sheet of nitro-cellulose as a protecting medium, not realizing the physical characteristics of the material and not acquainted with the details of its manufacture, which preclude its further oxidation by ordinary atmospheric influences. In order to convince manufacturers it was a favorite plan to lacquer silver articles and subject them to the fumes of burning sulphur.

The total gross sales of lacquer for coating metals for the first year, which were carefully tabulated and preserved, did not cover a reasonable compensation and traveling expenses.

The details of these efforts, tragedies then but comedies now, would fill a book and make humorous and interesting reading, but could not be condensed in a brief history of this art.

There are many manufacturing concerns in the United States and Europe equipped with lacquering departments who cannot recall the fact that they once doubted that metal articles would be generally coated with lacquer, because the "doubter" is gone and a "new king" has arisen who knew not Joseph."

(To be continued.)

The Universal Metals Co., Pittsburgh, Pa., has been successful in its equity suit against the American Metal Co., having secured a perpetual injunction restraining the latter company from making, selling, leasing or disclosing a secret formula for hardening copper, which is the property of the Universal Metals Co.

"ANODES AND PLATING SALTS."

Every plater is interested in anodes and plating salts. He has got to be. He makes his living by keeping in good humor with them and by keeping them on friendly terms with his work. Realizing this, the Munning-Loeb Co., Matawan, N. J., has just issued its "Bulletin No. 600" entitled "Anodes and Plating Salts" presenting a study of the various types of anodes made by the company and giving interesting information on anode characteristics, their efficiencies, and the effect of their shapes and illustrating the reading matter by photographs of anodes in various stages of disintegration. The bulletin also contains a special discussion on single and double nickel salts. This discussion is worthy of careful thinking by the reader if only for comparative purposes. This bulletin is well worth writing for. It will be sent upon request by the company to any address and a list will also be given of similar bulletins which have been issued on special electroplating subjects. Kindly mention the "Brass World" when writing for this.

PURITY OF PLATING CHEMICALS.

The subject of purity of chemicals and other supplies used in the plating room is one that is at present agitating the minds of platers throughout the country. Standardization is in the air, and it will soon be impossible to foist "magic" salts of unknown composition on any electroplater or purchasing department.

As a step in the right direction, John C. Wiarda & Co., Brooklyn, N. Y., importers and manufacturers of plating supplies, are sending out a letter to the trade, calling attention to the fact that the carbonate of copper which they sell is guaranteed free from sulphates and is a true basic carbonate. It is well known to platers that most commercial carbonate of copper contains varying amounts of a basic sulphate, which contaminates the solution, taking up a large amount of cyanide. Platers who use carbonate of copper should insist upon getting just what they ask for, viz., the true basic carbonate. John C. Wiarda & Co. back up their statements with the offer of chemical and practical tests and a liberal sample of their product, gladly sent on application.

METHOD OF ELECTROPLATING AND FINISHING ALUMINUM.

By JAS. A. HASLIP.

Various writers on aluminum plating have emphasized the difficulty of this work, and possibly my experience may be of assistance to readers. I have been successful in this class of work, as will be seen from the photographs below. My method of treating aluminum before plating is as follows:

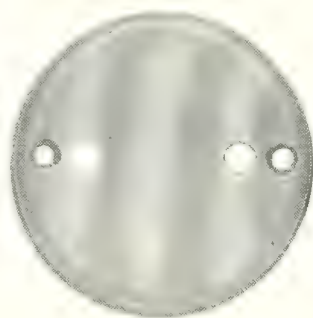
The articles should be polished in order to get a smooth surface, the same as is done in the case of other metals.

cles are now passed through a dip of two parts nitric acid and one part sulphuric acid to remove any oxide formed by the operations through the alkali bath. These operations must be executed with most painstaking exactness because on them chiefly depend the success of the electro-plating process. The articles are now ready for the nickel solution, which should be slightly acid; deposit with a low current density. In order to be given a high luster after plating the articles must receive a heavy deposit.

The articles having been thoroughly covered with nickel, care being taken during the process that the articles do not become dry, since other metals do not adhere well upon articles



Nickel-Plated
Aluminum.



Oxidized and
Lacquered.



Coppered, Oxidized
and Lacquered.

The most important part of the process is in the cleansing before immersing in the bath, as more than ninety-five per cent of the operator's difficulty in having the metal adhere firmly can be traced to improper cleansing or rinsing.

Remove the heaviest oils, greases and compositions by washing through benzine or gasoline and putting through dry sawdust to absorb surplus. Then wash in hot potash or caustic soda for a short time only, one quarter pound to each gallon of water, until gas bubbles appear; then rinse in cold water, brush with water and fine powdered pumice until all traces of grease and oil are removed. The articles will have lost their high luster put on by the polishing operations, but the smooth surface will remain, providing articles are not immersed in alkali bath for too long a period as this would pit or frost articles. The arti-

cles which have become dry, they are now ready to receive any deposits of other metal or finish desired.

Aluminum can be oxidized to resemble oxidized silver in the following dip; one gallon muriatic acid; two ounces, arsenic; one ounce, sulphate of iron; two ounces, sulphate of copper. It should stand at about fifteen degrees Bé. Clean articles of heavy greases, oils and compositions as for plating, before immersing in the dip; it should then be potashed until gas bubbles appear, then rinsed in cold water and afterwards oxidized.

It will come from the dip a jet black and while wet can be striped by using a cloth with powdered pumice, or by drying if scratch-brushed can be toned a dark gray,—can also be relieved with light sand blast. It is then lacquered, using dip or spray.

TREATMENT OF STOVE CASTINGS PREPARATORY TO PLATING.

By HARRY E. STARRETT.*

(Continued from page 67, February 1915.)

The Five-Wheel Operation.

In the five-wheel operation the process consists of roughing, dry fining, second fining, oiling, and greasing and finishing. Different wheels are employed by different concerns for roughing. Some of the least progressive use paper wheels or a hard canvas wheel made of sail-cloth discs glued together. The more modern and up-to-date concerns use a cemented canvas wheel or a cemented cloth wheel for roughing. These wheels have a resiliency and elasticity which prevent gouging the work, and insure that the roughing-out is uniformly done. The grade of emery used on the roughing wheel varies from No. 60 to No. 90 according to the smoothness and hardness of the casting.

The dry fining operation is similar to the roughing, with the exception that a finer emery is used. In roughing the wheels are run over the article in one direction. In fining, the wheel is run crosswise over the roughing operation, which takes out the roughing scratches and when possible, in the second fining the direction of the wheel should run diagonally across the two preceding operations.

The emery used on fining is generally two grades finer than the roughing. The emery used in the second fining work is one or two sizes less than used on the first fining wheel.

The character of wheel used for oiling or greasing varies. Some of the stove companies employ the cemented canvas wheel with excellent results. Others use the Universal wheel. The bullneck or felt wheel, however, is in more general use. With most companies the grease wheels are set up with emery ranging from No. 120 to No. 180 and then worn down by running it over a few pieces

of work. Emery cake, crocus, tripoli or tal-lowene is then applied to the surface of the wheel on which the work is polished for the greasing operation. The direction of the wheel over the work in this operation is optional. If any of the roughing scratches still appear it would be well to run the wheel crosswise to the direction used in roughing, but, if the preceding operations are properly done there should be no deep scratches left for the grease wheel to take out.

When the grease wheel clogs up, lump pumicestone is applied to clean it out, and what is termed "liven" it.

The finishing wheel is the last operation. A well-worn grease wheel is generally used for this purpose, the wheel itself being nearly always felt. The operation differs from greasing from the fact that a very hard flintstone is worked over the grease wheel, giving a high polish to the surface. When the work passes over this it brings out the lustre, wears down any semblance of scratches in former operations and leaves a high-grade finish. The higher the polish secured on the casting the better nickel finish can be produced. We will show in our directions on buffing that methods can be employed that will eliminate considerable polishing, if buffing is properly done.

The Four-Wheel Operation.

The four-wheel work is finished similar to the first except that the second finishing or fining is omitted. In some shops the work runs first over roughing, then fining, then second fining while in other places they rough out, fine, grease and finish. The first procedure is preferable.

The Three-Wheel Operation.

The three-wheel work is finished on a roughing wheel, dry finish and grease wheel.

*Western Sales Manager of Hanson & Van Winkle Co., Newark, N. J.

Emery Sizes.

The size of emery used does not change materially in the three grades of work. For illustration:

1st Class

- No. 60 for roughing.
- No. 90 for fining.
- No. 100 for second fining.
- No. 120 to No. 150 for oiling.
- No. 150 to No. 180 for finishing.

how they are set up ready for operation. We will therefore omit going into detail on this point, and will next take up briefly the equipment best to use on the polishing room of a stove factory.

Polishing Room Equipment.

In a small shop, polishers as a rule are supposed to take care of their own wheels. In the larger shops a room is set apart called the wheel-room, this being in charge of a com-



The Polishing Room of Cribben & Sexton Plant, Chicago, Ill.

2nd Class

- No. 60 for roughing.
 - No. 100 for fining.
 - No. 100 to No. 120 for the next operation.
 - No. 120 to No. 150 for the final operation.
- regardless of whether oil or finishing wheel is used.

3rd Class

- No. 60 for roughing.
- No. 100 to No. 120 for fining.
- No. 120 to No. 150 for oiling or greasing.

Nearly all text-books give detailed description of what these different wheels are and

petent man who attends to all details and is an expert in setting up wheels.

When a polishing wheel is worn close (the emery worn off) the wheel surface is cleaned with a buff stick. This is usually a 2 in. square pine stick, about 20 to 24 in. long, covered with glue which is rolled in coarse emery of No. 18 or No. 24 grade. Two or three coats of glue and emery are applied to this stick, each coat being allowed to dry thoroughly. Glue is an important factor in the preparation of the wheel. A high-grade hide or fish glue is preferred. The glue is

first soaked in all the water it will take up, then cooked to a consistency so that it will just run off the end of a brush. It is important that the wheels be set up uniformly and that the same consistency of glue be used at all times, otherwise the polisher will find himself out of wheels before his day's allotment of work is turned out.

A set of wheels for a polisher in the average shop consists of from 6 to 8 roughing

pendent on pegs which are a trifle smaller in diameter than the size of the holes in the wheels. It is assumed that the wheels have been properly balanced before being hung on the racks. Cast-iron individual emery trays can be satisfactorily used for containing the emery for setting up the wheels. Care should be taken to keep all trays covered when not in use in order that the different grades of emery may not become mixed.



Partial View of Cribben & Sexton Electro-Cleaning Department.

wheels, 6 to 8 fining wheels and 2 to 3 greasing wheels. When finishing wheels are used one should last a polisher several days. Modern practice calls for a proper equipment; glue heaters with ample capacity to contain sufficient glue to set up all the wheels required should be provided. There should be as many separate glue vessels as there are sizes of emery used, for it is best that each glue heater should be used in setting up a wheel with certain size emery and never changed. When wheels are set up they should be hung on special racks and dried; they should be sus-

Buffing and Finishing.

Finishing of work after being plated differs in methods very little in all the large shops in the West. In that section of the country after it is nickel-plated, the work is buffed with bleached atlas buffs. This is a pieced, sewed wheel, the average size being 14 in. In some cases, however, a 16 in. buff is used. In the West a very heavy deposit of nickel is put on the work. This is cut down with the pieced atlas buff, using a white finish, and is polished on the same kind of wheel, using a lime composition. In former

years all buffing of cast-iron trimmings with a background was done with a felt wheel; the plain parts with an 18-ply muslin buff. The felt wheel is now practically eliminated in the West; the atlas buff takes its place, and also of a loose muslin buff. Notwithstanding the care that is taken in all shops to get the scratches out of the work, there is sometimes a trace of emery marks left in the casting, which is well covered by the heavy deposit of nickel. This is cut down as above so that the scratches disappear. Buffing work in this manner naturally leaves a background full of dirty composition and for a long while it was quite a problem to clean this out, but this can now be more satisfactorily done by the use of a solution of "Essex" nickel cleaner, about three or four ounces to the gallon, brought almost to the boiling point. The work should be left in this for 15 minutes or more and the background scrubbed with a soft tampico or bristle brush. This "Essex" cleaner loosens up the greases so that it is a very easy matter to remove them if all conditions are right.

This cleaner can also be used as an electric cleaner, using the work as an anode and leaving it in the cleaner for two or three minutes. In this way it cleans the work out very quickly and does not seem to affect the polished surface. When the background is properly cleaned, it is again rinsed off in clean cold water, then in hot water and then dried off in sawdust. In some shops where they have inspectors the whole article is rubbed off with a cotton flannel rag on which fine whiting is applied.

(To be continued)

INCREASING USE OF MONEL METAL.

It is interesting to note the growth of a business founded upon the merit of a product and its adaption to continually increasing uses in different fields of industry. Monel metal is a nickel-copper alloy with an approximate composition of 67 per cent nickel, 28 per cent copper, the remaining 5 per cent containing no tin, zinc or antimony. In 1909 about 12,000 lb. of metal were produced while in 1914, over 300,000 lb. were marketed. The weight of the castings made from the metal varied from 1 oz. to 18,000 lb.

The melting point of Monel metal is 1360 deg. C. or 2480 deg. F. Its tensile strength on

the castings is 72,281 lb. to the sq. in. and its elongation in 2 in. is 34 per cent. The tensile test on rods gives a tensile strength of 88,232 lb. per sq. in. with an elongation in 2 in. of 42 per cent.

Monel metal may be forged by heating it to a temperature of 600 deg. to 900 deg. C., or 1,112 deg. to 1,652 deg. F. It is preferable to heat the metal in a muffle furnace, although it can be done in a gas or oil-fired furnace where a neutral or slightly oxidizing flame is maintained, nearly free from sulphur. It is important in forging work that there should be the least possible loss of time in the handling when the metal is withdrawn from the furnace as Monel metal loses its heat very quickly.

A few years ago Monel metal was unknown as a material for marine construction. Numerous tests and experiments revealed its strength, suitability to marine work and its resistance to salt-water attacks. Its high modulus of elasticity makes it specially suitable for propeller work. Monel metal shows a modulus elasticity of 22,000,000 to 23,000,000 as compared with that of steel of 28,000,000 to 32,000,000. Some of the best ships of the American Navy, such as the "North Dakota" and the "Florida", are driven by Monel-metal propellers. Monel-metal cannot be welded under the hammer, but can be autogenously welded either by electricity or with an oxy-acetylene flame. Monel pig-metal is produced extensively by the International Nickel Co., New York City, and Monel metal castings are the specialty of the Bayonne Casting Co., Bayonne, N. J., to whom we are indebted for much of the data furnished. The Bayonne Casting Co., distributes a special treatise on Monel metal which is interesting and instructive and can be obtained upon application.

By a contract closed between Thomas A. Edison and the Cambria Steel Co., Johnstown, Pa., the former is given the right to build a plant to take the benzol out of coke gas. Construction of the plant, which will cost \$25,000, has been started and when it is completed it is expected the Cambria Steel Co. will furnish 1,500 to 1,800 gallons of benzol daily. Before the European war, benzol was obtained at only three or four points in the United States, most of the product used in this country being imported from Germany. With that source cut off, the price of benzol has doubled, prompting the opening of local fields.

SPECIAL DEMONSTRATION OF METAL CYANIDES AT LEWIS INSTITUTE, CHICAGO, ILL.

It is an interesting thing to note that the study of electroplating problems is being taken up by many of the important educational institutions of the country. In several of the large cities, such as St. Louis, Buffalo, Philadelphia and Chicago, the leading universities and colleges are co-operating with the electroplaters to mutual advantage, an excellent evidence of which was furnished by the interesting talk made by Prof. Lukens at the recent New York banquet.

On Thursday evening, February 11th, at 8 p. m., a special meeting for the study of cyanides was held in the auditorium of the Lewis Institute, Chicago. The attendance was about 300 and the audience was comprised of members of the American Chemical Society, the American Electro-Chemical Society, the American Electroplaters' Society, manufacturers of electroplated wares, members of the different universities in Illinois and Wisconsin, and others interested in this branch of scientific investigation. Prof. Woodworth of the Lewis Institute, presided over the meeting and in his introductory remarks stated that the Lewis Institute had long realized the constantly increasing scope of electroplating effort and development and welcomed the present opportunity of making a practical study of the most recent improved additions to electroplating materials. The meeting, being composed of practical and technical men, would undoubtedly be productive of profitable discussion. By special request, similar demonstrations had already been made before the day and evening classes of the Lewis Institute. The following papers were then read by Carl Dittmar and Max G. Weber of New York City.

THE ADVANCE OF THE PLATING INDUSTRY.

By CARL DITTMAR.

The plating industry has grown steadily each year and now its scope is considered almost unlimited. This fact is causing the manufacturer and the technical man to pay more attention to this branch of industry than ever before. With this growth competition

has grown keener, which, in turn, has drawn the attention of the efficient expert to the plating department.

There is hardly a large manufacturing plant where a cost system has not been introduced to determine the cost of operating the plating department. The manufacturer has called for increased output, and in order to enable the plater to meet this demand, has installed modern equipment. He has installed high efficiency electrical apparatus. The plating barrel or mechanical plating tank was introduced and is steadily growing in favor, as it enables the plater to handle a large amount of work at one time, thus reducing labor cost. Only the most important part of the electroplating department has been neglected—the solution itself. The expense and the possibilities of the electro-plating field have now drawn the attention of the technical man to this most vital part of the electro-plating industry.

It is only during the last few years that the chemist has been consulted. That electroplating is simply a branch of electro-chemistry and a very important one, was recognized for the first time when the American Electro-Chemical Society gave a symposium on Electro-plating at their meeting at Atlantic City in April 1913, to which the American Electro-Platers' Society was invited. This was the first meeting of the practical man and the theoretical man for the purpose of discussing electro-plating problems and that meeting has done much towards dispersing the prejudice which the practical plater has had against the chemist, whom he considered nothing short of a "meddler." The plater now looks upon the chemist as a friend who can help him out of the difficulties which present themselves from day to day. Another step in this direction has been taken by the Bureau of Standards at Washington, which has undertaken to standardize acid plating solutions, and it is only a question of time when the matter of alkaline or cyanide solutions will receive the same consideration. Now this institution, recognizing the unlimited scope of the electro-plating field, has taken the initiative in bringing the matter before its students. This is being done for the sole purpose of increasing the efficiency of plating solutions. In order to obtain maximum efficiency in the plating department the plater must be positive that the solution has been made up not only most economically but with

materials which will assure perfect deposits in the shortest possible time.

The plater is now working in harmony with the chemist. He is becoming more intimately acquainted with his solutions. He wants to know what he can expect of his bath in a given time. In order to be able to do this, however, there must be eliminated from the plating solution not only detrimental matter, that is, material which actually retards the action of the current, but also that which does the solution no good. He must eliminate all ingredients which lie dormant in solution, and confine himself to materials which serve a specific purpose. All he draws from his solution is metal, and this factor should, therefore, receive the most consideration. It should be introduced into the bath in the purest state possible at the lowest cost.

The next consideration is the electrolyte, which reduces the metal from the anodes and deposits it upon the cathode. In the joint investigations of the chemist and plater it has been brought home that in the past the plater has been working under serious handicaps. He has been compelled to get results with all conditions against him, being compelled to use materials which contain large proportions of impurities, the nature of which he had no way of determining. The metal salts have varied in metal contents so that he was never sure just how much metal he was introducing into his bath. This was the first phase of the electro-plating art which the chemist investigated in order to determine how this constantly increasing inert matter effects the solution. It has been found that it not only does the bath no good, but, in fact, is positively detrimental. It is a fundamental rule in electro-chemistry, that the best results are obtained only when purity of materials is combined with simplicity of application, and it is the object of this demonstration to point out to the chemist and the plater alike, that this ideal condition can be arrived at by the use of metal cyanides.

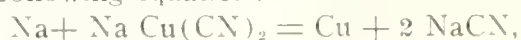
COPPER CYANIDE PLATING SOLUTIONS.

By DR. MAX G. WEBER.

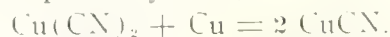
I have chosen as a subject the working of a copper bath, as this is by far the most extensively used and also the most instructive solution.

There are three things which are necessary for the deposition of metal, current, electrode and electrolyte, or plating solution. As the plating solution is the most important, I will confine myself to this item.

The object in employing cyanide solutions for the deposition of copper is to be sought in the fact that in such solutions iron does not replace copper, notwithstanding their places in the electrolytic series, a phenomenon which is due to the complexity of the salt in which the copper is present. The complex salt, which makes this feasible, is the double cyanide or sodium copper cyanide, the anion of which is Na , the cation $\text{Cu}(\text{CN})_2$; that is, by the action of the electric current, Na travels toward the cathode, and $\text{Cu}(\text{CN})_2$ toward the anode. In other words, copper is not present in an ionized stage. Under proper current conditions, *i. e.*, not too high current density and a suitable concentration of the solution, Na is not discharged at the cathode, but reacts with an undissociated part of $\text{Na}(\text{CN})_2$, as shown in the following equation:



proving that the deposition of copper is a secondary reaction, and that free cyanide is formed. On the anode, the anion $\text{Cu}(\text{CN})_2$ combined with the copper of the electrode, forming cuprous cyanide,



Cuprous cyanide is insoluble in water, but soluble in cyanide solution, and for this purpose the free cyanide generated at the cathode is required. Supposing we have proper conditions—low current density on both electrodes—enough free cyanide is produced on the cathode in order to keep in solution the cuprous cyanide formed on the anode. As the free cyanide of the cathode is really needed on the anode for dissolving purposes, and as in a still solution the mixing velocity is very slow, stirring and warming of the electrolytic bath would expedite this matter considerably and bring the bath very near to an ideal stage. However, warm and agitated solutions require a more careful observation, for which reason these two items have not as yet been paid the attention they actually deserve.

If a too high current density is used on the cathode, all the Na ions do not act on the sodium copper cyanide reducing it, but they are partly discharged, forming sodium hydrate and hydrogen by acting on the water of the bath:



This reaction accounts for the development of hydrogen or gasing at the cathode. It means that less copper is deposited per current unit and not sufficient free cyanide is formed in order to keep the anode clean. The solution therefore needs the addition of sodium cyanide, as otherwise the anode becomes coated and the passage of the current is interrupted. A too high current density on the anode leads to the same results, viz., covering of the electrode with an insulating film of cupri-cupro cyanide.

In regard to current density, it must be borne in mind that warmed and agitated solutions can be worked with a higher current density than cold ones, and that a density of approximately 30 amp. per sq. ft. is quite feasible without yielding a burned and blistered deposit.

Another feature which is quite interesting is the amount of metal deposited per amp. hr. In a copper cyanide solution which contains the metal in the cuprous stage, the same amount of current should yield twice as much metal as in an acid bath, providing, of course, all the favorable conditions are prevailing, i. e., a strong solution, warmed and agitated, worked with a minimum amount of free cyanide at a low current density. As, however, common plating solutions are worked on nearly the contrary conditions, the relative amount obtained from a cyanide bath is much lower. How much lower depends entirely on the relative conditions, and only one feature should be emphasized, which has been mentioned above: that the more hydrogen develops on the cathode, so much lower is the percentage of the metal deposited per current unit. A low current density results in a high percentage of the metal deposited per electrical unit, while the deposition is slow. A high current density yields a lower percentage proportionately, but consuming less time for a certain amount of metal deposited, there results a greater deposition of metal per time unit.

Furthermore, cyanide solutions yield a finer, more homogeneous texture and brighter metal film than the acid baths on account of the secondary copper deposition and because hydrogen may develop more freely on the cathode in such a solution without fear of burning or blistering the deposit.

These few remarks give an idea how complicated the reactions in a plating solution are, and that it requires skill and experience to procure a satisfactory deposit.

(To be continued.)

THE CORE-ROOM IN THE BRASS FOUNDRY.

By R. MICKS.

The core-room in the brass foundry very rarely ever receives the thought and attention that is needed to bring its output up to the highest point, both in quality and quantity, and for this reason the core-room is responsible for a goodly amount of the discount and scrap that all brass foundries have to contend with.

Sand and Binders.

For the ordinary cores used in brass foundries bank sand and molding sand give very good results, but for valve cores and other intricate cores it is advisable to use silica sand. This sand is more costly than bank sand, but it will be found to be cheaper in the end, as it can be mixed with linseed or good core oil in the proportion of one part oil to 50 or 60 parts sand. It very seldom ever blows as it is very open and it also possesses great heat-resisting qualities.

There are many core binders on the market, and no doubt they will all work out to advantage on certain classes of work, but for reliable all-round binder, linseed oil and rosin are in a class by themselves and can always be relied on to give the best results in all classes of work in the brass foundry. Rosin has many advantages as a binder for core-sand, it being cheap and cores made with it baking quickly, which latter is a great advantage if the plant is short of oven space. It is largely used for small thin cores and tends to preserve the sharp corners better than most binders. It can also be recommended for cores that are hard to vent, as the gases produced from the rosin escape and ignite very freely thus lessening the chance of blow-holes in the castings in which these cores are used.

All sand for cores should be perfectly dry before the binder is added for if not, the binder will not mix well with it and this will cause the cores to be streaky and crack. Care should be taken in adding the binder, the right amount being used, no more and no less, as guess-work will only cause a loss of time and material.

Core Boxes.

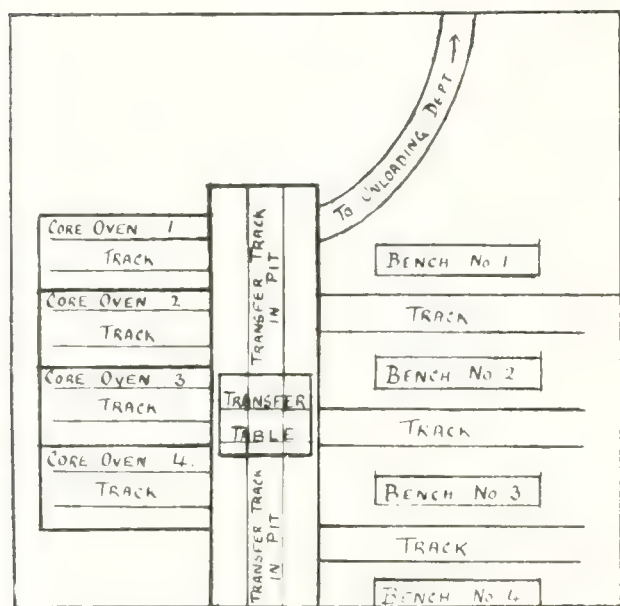
To obtain the best results in the core-room the core boxes must be up-to-date, and must be kept in first-class condition for many pounds

of castings are discounted on account of the core box getting out of shape.

Gang boxes should be used for all small cores, with as many spaces in it as can be nicely handled by the maker, and for the larger and intricate cores, dryers give the best satisfaction as they keep the cores in perfect shape.

The Ovens.

The core ovens should have constant attention. To get good results the temperature should be kept up to about 500 deg. F. in the daytime and allowed to drop to 350 deg. at night, in order not to burn the cores that are left in the oven over-night. The smaller cores must be placed on the lower shelves and the larger on top; this will give them the right amount of heat required for the different cores without burning them. The distribution of the flues is another important point in the core oven for it is necessary to have uniform heat in the oven in order to secure best results. Poor flue arrangement causes many ovens to be hot at the bottom and cold at the top and conditions of this sort are bound to retard production.



Economical Arrangement of Core-Room.

General Arrangement of Core Room.

It is very important that the core benches and ovens should be placed so as to do away with all waste energy on the part of the core-maker, as an extra step or two with every plate of cores amounts to considerable time in a day. In the diagram of a core room herewith shown, a system is illustrated where there is no waste energy whatever.

The core buggy tracks are laid between the coremakers' benches and as soon as a workman finishes a plate of cores he can turn around and without a single step, place his cores on the rack of the core buggy. When the buggy is loaded it is shoved out on the transfer table, which enables the operator to put the cores in any oven desired. When the cores are baked they are run off on a branch track to the unloading department.

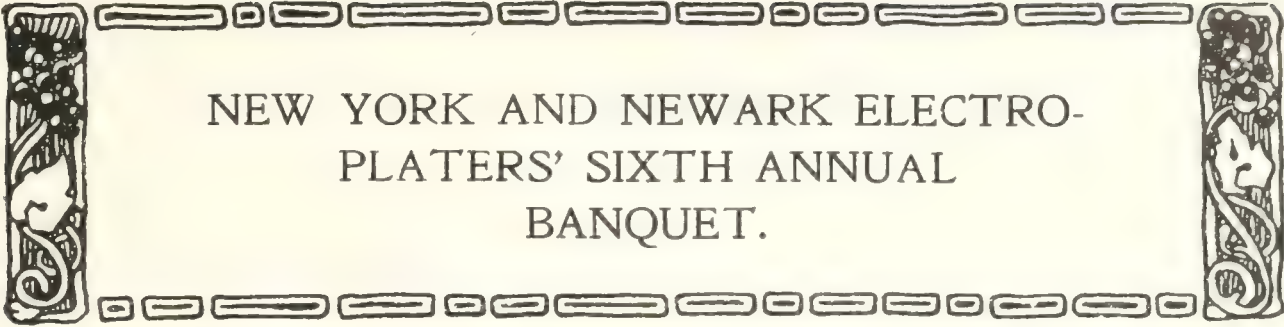
A little thought and study of the conditions in the core-room is bound to give results both in the quality and quantity of production. This in return will also help the output of the foundry, since good cores help to make good castings, and good castings produce more orders.

To have a perfect system in any plant, the small details must be considered as well as the larger ones. Every man should be placed at the class of work he is best fitted for, places should be provided for tools and material and the foreman should see that all tools are kept in their place when not in use, as many hours are wasted in hunting for tools mislaid by careless workers.

A MARVELOUS NEW METAL.

An explorer of Asiatic Russia is reported to have returned from his explorations with news of a remarkable metal, samples of which he brought back with him and had analysis and experiments made of it by chemists in Moscow. Among the properties claimed for this metal is the following: In the presence of an acid it generates such an excessive degree of cold that the glass vessel containing it is immediately reduced to powder. Similar results followed when an iron vessel was used for the purpose, even when current was used. The latter was suddenly decomposed without either an explosion or emanation of gas, but with a stupefying lowering of the temperature. The unknown substance is said to be an opaque pasty mass, quite heavy and so found lying among mica and other minerals.

The Wolverine Brass Works, Grand Rapids, Mich. recently distributed to its stock holders its annual dividend on common stock paid at the rate of 10 per cent in preferred stock and 2 1-2 per cent in cash.



NEW YORK AND NEWARK ELECTRO- PLATERS' SIXTH ANNUAL BANQUET.

What is considered by American electroplaters as the second event in importance of the year, the first being the National Convention, took place at the Broadway Central Hotel, New York City, February 20, 1915. Besides being a meeting-place for members of the New York and Newark branches of the American Electroplaters' Society, this annual function is really the rendezvous of electroplaters of the East in general, including platers from the manufacturing centers of New York, New Jersey, Pennsylvania, Connecticut, Massachusetts, Rhode Island and even Virginia.

The banquet was timed to commence at 8 p. m., but from before noon until the actual time for eating, the hotel kept receiving electroplaters and guests from out of town. An exhibit room was provided, in which excellent examples of the plating art were displayed by members of the two branches. This room, as usual, served also the usual purpose of a place where free exchange of opinions and ideas, and renewal of friendships, could and did, find expression. Platers of the old and new types here rubbed shoulders and exchanged views, each learning much from the other.

The banquet itself was a splendid success, and after everyone had been accommodated with room at the tables, it was announced that the attendance had reached the two hundred mark. A spirit of fraternity manifested itself throughout the repast.

The time remaining after the banquet for speech-making being short, it was announced by the Toast Master, Harry de Joannis, that no speakers but those whose names appeared on the program, would be called upon. These honored guests were Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.; Dr. Hiram Lukens, Harrison Chemical Laboratory, University of Pennsylvania, and A. K. Selden, Crocker-Wheeler Electric Co., Ampere, N. J.

Before calling on the first of these speakers, the chairman read a long, enthusiastic letter of congratulation from Supreme President J. H.

Hansjosten, Kokomo, Ind., in which he spoke of the growing influence and importance of the Society from coast to coast. President Hansjosten's thoughtful and earnest communication called forth hearty applause from all present.

In a few words, Professor J. W. Richards was introduced as the secretary of a kindred society, the American Electro-Chemical Society, the first meeting of which brought an attendance of 350 earnest and progressive men and whose membership and output of work now compare favorably with those of any similar society in the world.

Dr. Richards explained first the title of his address, "Electroplating: The Daddy of Electrometallurgy." He showed how the kindred sciences of electrochemistry and electrometallurgy owed their origin to the work accomplished by the early electroplaters, who made these sciences possible. An interesting fact cited by the speaker was that while modern works on electrometallurgy deal exclusively with the extraction of metals from their ores and their refining by electrical means, the first works on this subject dealt with a very different subject matter, viz., the deposition of metals upon other metals by electricity, known now the world over as "Electroplating." This can be verified by reference to such work as Smee's 'Elements of Electrometallurgy,' published in 1813, and treating entirely of electro-deposition. These early electroplaters by their quiet, conscientious research in dark and ill-equipped workshops, laid the foundations for the three great sister sciences of Electrochemistry, Electro-metallurgy and Modern Electroplating, which have raised the metal industries of the world to such a high pinnacle of efficiency and usefulness.

The second speaker to address the gathering was A. K. Selden, of the Crocker-Wheeler Electric Co., Ampere, N. J., one of the largest firms manufacturing plating dynamos in this country. His subject was appropriately entitled "The Modern Dynamo", and he showed

clearly to what a pitch of perfection the evolution of the dynamo has progressed. The subject of his talk was purely technical, but instructive as furnishing light on the other important factors in the plating process besides chemistry. Detailed figures were given concerning modern advanced types of dynamos construction both for A. C. and D. C. systems.

Dr. Hiram Lukens was the last speaker of the evening. His presence is sufficient testimony to the advance of the electroplating art,

accurate results in connection with the Philadelphia branch. He pointed out how many platers were confronted with long and clumsy volumetric and gravimetric methods of finding the metal contents of their solutions, when all the time they had the most perfect conditions desirable for analysis by electrolytic methods. The plating solution is all prepared for the current to separate the metal from the other constituents; nothing is to be added or subtracted. Dr. Lukens showed the small platinum



and to the gradual drawing together of the practical plater and the modern chemist. The Philadelphia branch has been greatly assisted by him in their striving towards true scientific work, just as other branches have gained through the cooperation of university professors. Dr. Lukens made a valuable contribution to the evening's success, by explaining in detail, a simple method for platers to analyse their solutions, as worked out by him and used with

cup he uses for this work, in which the metal is all deposited on the inner surface. The solution is weighed beforehand, as also the platinum cup, in which it is placed. A current of sufficient strength is passed to deposit the whole of the metal in the cup, the liquid is then thrown out and the cup dried by alcohol and ether. The increased weight of the platinum cup represents the weight of metal deposited from a weighed amount of solution.

An alternative method was presented, substituting a glass vessel for the platinum cup and thereby cutting down the cost, but this was not claimed to give as accurate results.

This interesting exposition was well received, and questions asked by platers present were answered by Dr. Lukens, who thus added further to the high opinion already formed of his ability and knowledge of plating difficulties and conditions.

BANQUET NOTES.

Badges were presented to those who attended, by Maas & Waldstein, New York City.

A beautiful souvenir of the banquet, in the shape of a small pocket-knife, with lacquered heft, was the gift of the Celluloid Zapon Co., New York City.



The hour of midnight fast approaching, the meeting was brought to a fit conclusion with a story from the chairman, illustrative of the need of cooperation of all the members. Thus ended a most enjoyable banquet convention, remarkable for the enthusiasm provoked and giving great hope for the future of these two live branches of the American Electroplaters' Society.

The Egyptian Lacquer Co., New York City, furnished the cigars.

The Eureka Pneumatic Spray Co., New York City, presented each guest with a box of matches in a neat celluloid holder.

A boon to pipe-smokers, in the shape of pipe-cleaners, etc., was given to each conventioner by Henry Ringhof, Newark, N. J.

A SHORT OUTLINE OF THE PRINCIPLES OF CHEMISTRY FOR ELECTROPLATERS.—VIII.

By ALLAN J. FIELD.

(Copyrighted by the author.)

The Third Group.

Iron and aluminum are taken together to form the third group. The chief property that distinguishes these two metals from the metals of the other groups is the insolubility of their hydroxides in ammonium hydrate in the presence of ammonium chloride.

Iron has two classes of salts, ferrous and ferric, and as these two kinds of salts behave differently with the same reagent they will be taken up separately. The difference in composition between the ferrous and ferric, just as with mercurous and mercuric salts, is that the ferrous compounds contain more iron in proportion to the acid radicle with which it is combined than in the ferric compounds. For example ferrous sulphate, (Fe SO_4) contains 36.76 per cent iron and 63.24 per cent SO_4 . The ferric sulphate $[\text{Fe}_2 (\text{SO}_4)_3]$ contains 27.93 per cent iron and 72.07 per cent SO_4 . Sometimes the term valency is used to describe these compounds, that is, the iron is said to be divalent in the ferrous salts, and trivalent in the ferric salts. To illustrate more fully, the sulphate radicle (SO_4) has a combining power or valency of two, therefore in ferrous sulphate (Fe SO_4) , as we can see, from the formula, there is only one of iron combined with it, the iron must have also a valency of two. In the ferric sulphate $[\text{Fe}_2 (\text{SO}_4)_3]$ there are three molecules of (SO_4) , each having a valency of two, making six altogether; there are two atoms of iron; therefore each one must have a valency of three.

It was pointed out at the time the theory of dissociation was discussed, that when salts are dissolved in water they break up into two parts, one part charged with positive electricity, and the other part with negative electricity. Before the salt dissociates, it does not show indications of being charged with electricity because the negative and positive charges neutralize each other. This theory helps to make clearer the idea of valency, as in the case of ferrous sulphate which dissociates into positive atoms of iron and negative atoms of (SO_4) . Stated in the language of valency we can say the iron is charged with two positive

bonds or units of valency and the sulphate radicle with two negative bonds. The sum of the minus and plus bonds of the atoms forming a salt is zero. The amount of electricity an atom carries therefore depends upon the valency. Copper in cuprous chloride (Cu_2Cl_2) has a valency of one and in cupric chloride (Cu Cl_2) it has a valency of two. An ion of cuprous copper will therefore carry only half as much electricity as an ion of cupric copper. It follows then that the same amount of electricity will deposit twice as much copper from a cuprous chloride solution as from a cupric chloride solution.

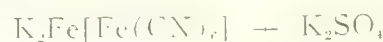
Ferrous Compounds.

Perform the following tests on a dilute solution of ferrous sulphate $(\text{Fe SO}_4, 7 \text{ H}_2\text{O})$.

(1) To 5 c.c. in a test tube add ammonium hydrate in slight excess; a light blue precipitate will form; if the solution is heated the precipitate will become black, because the ferrous hydroxide has been partially oxidized by the oxygen in the air to ferrous-ferric hydroxide.

If much ammonium chloride is present it will hinder the precipitation of ferrous hydroxide. To completely precipitate the iron it is therefore necessary to oxidize it to the ferric state; the presence of ammonium salts does not affect the precipitation of ferric hydroxide. Ammonium chloride will also prevent the precipitation of nickel, manganese and zinc by ammonia; for this reason ammonium chloride is always added when precipitating the third group.

(2) To another portion add 5 to 10 drops of a dilute solution (10 per cent) of potassium ferrocyanide; a light blue precipitate of potassium ferrous ferrocyanide, $\text{K}_2 \text{Fe} [\text{Fe} (\text{CN})_6]$ will come down.

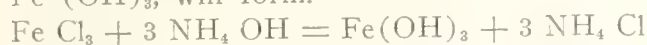


Add a few drops of dilute nitric acid and heat; the precipitate will change to a dark blue known as prussian blue or ferric ferrocyanide, $\text{Fe}_4 [\text{Fe} (\text{CN})_6]_3$.

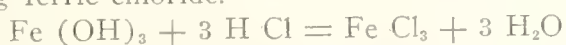
Ferric Compounds.

Prepare a dilute solution of ferric chloride (Fe Cl_3) for the following tests:

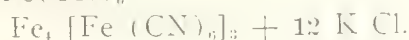
(1) Add ammonium hydrate to a portion; a reddish-brown precipitate of ferric hydrate, $\text{Fe}(\text{OH})_3$, will form.



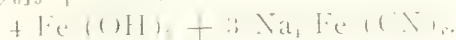
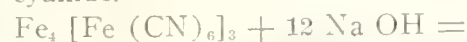
Add about 5 c.c. of a 5 per cent solution of sodium hydrate and heat; the ferric hydrate will not be dissolved. Add dilute hydrochloric acid, which will dissolve it immediately, forming ferric chloride.



(2) To about 5 c.c. of the ferric salt solution add a few drops of potassium ferrocyanide solution, which will precipitate prussian blue.



Add about 5 c.c. of 5 per cent sodium hydrate solution to the prussian blue; it will decompose it into ferric hydroxide and sodium ferrocyanide.



The reactions between iron salts and potassium ferrocyanide is very interesting, on account of the fact that the reagent, potassium ferrocyanide, contains the very metal which it is used to detect. The reason is that potassium ferrocyanide dissociates when dissolved in water into potassium ions and ferrocyanide ions, $\text{Fe}(\text{CN})_6$.

The ferrocyanide ions do not give the reactions for iron when treated with reagents. If the ferrocyanide compound is broken up, that is, if it is heated with sodium hydrate, the iron will then give the reactions.

Aluminum.

A dilute solution of aluminum sulphate can be used for the following tests.

(1) To 5 c.c. add ammonium hydrate; a white gelatinous precipitate of aluminum hydroxide, $\text{Al}_2(\text{OH})_6$, will be precipitated. It is slightly soluble in excess of ammonia; on boiling the dissolved hydroxide is reprecipitated. The presence of ammonium chloride will prevent the aluminum hydroxide from dissolving. To completely precipitate aluminum, ammonium chloride should be present. Ammonium chloride in this case acts in an exactly opposite way to when precipitating ferrous iron, nickel, manganese and zinc as hydroxides. Aluminum hydroxide is readily soluble in acids. It is quite soluble in sodium hydrate,

which distinguishes it from iron, as ferric hydrate is insoluble.



The compound formed is sodium aluminate. Ammonium hydroxide will not precipitate the aluminum from a solution of sodium aluminate. To do this it will be necessary to make it acid, then on the addition of ammonia the aluminum will be precipitated. Aluminum hydroxide has the property of acting as a base as well as an acid; zinc hydroxide behaves in a similar manner. When treated with strong acids, aluminum hydroxide acts as a base, but towards strong alkalis it will act as an acid as in the reaction with sodium hydrate.

(To be continued.)

THE EMPIRE FINISH.

By W. G. STRATTON.

This finish was patented in the early eighties and it may be new to some of the younger readers of the Brass World.

The first operation, assuming that the work has been highly finished and washed, is to brass-plate in a bright brass solution. It is then color-buffed with a soft filled cotton buff and red rouge. The speed should not exceed 1800 rev. per min. or the sharp corners may be cut off, in which case the article will have to be replated.

After a thorough washing, gold plate in a good gold solution, keeping it as bright as possible, and dry it out carefully with hard wood sawdust. The high lights are then to be painted with air-drying asphaltum thinned with turpentine putting it on heavy enough to cover the metal so that it does not show through, or in other words make it *black*. This paint should be kept at a temperature of 110 deg. F. while using, by means of a small steam pipe or electric heater as it flows better when warm. It is sometimes made tougher by adding one-fourth part of a solution of uncured rubber dissolved in bisulphide of carbon.

After drying for about one hour, dip the work into weak potash or similar cleaning solution not very hot; rinse quickly and swab the exposed parts with a cotton brush dipped in the same solution. It is better to coax the grease and finger marks from the surface with weak solution, as the strong hot potash will

lift the paint and make ragged edges instead of sharp lines.

When clean, pass through the mercury dip and strike very gently in the silver strike. Plate for eight or ten minutes in the regular silver solution. Let the work stay for a few minutes in the solution after the rheostat has been turned off, so as to whiten it. Then rinse and immerse in turpentine or benzole using a soft paint-brush to brush all the paint from the crevices, after which wash with Castile soap and warm water, brushing thoroughly with a clean soft brush. It is now ready to dry and lacquer with a good silver lacquer.

This is the original "Empire Finish," but very pleasing variations may be made such as depositing more silver- and oxidizing the same before removing paint, or by depositing the regular ormolu gold before painting and burnishing same after removing paint. Many other combinations will readily suggest themselves to an inventive mind, some of which may prove of value.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY.

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES.

New York—Meets fourth Friday of each month at Broadway Central Hotel, New York City, at 8 P. M. Secretary, Joseph Minges, 148 Schenk Avenue, Brooklyn, N. Y.

Rochester—Meets second Friday of each month at Hotel Rochester. Secretary, C. V. Haring, 306 Dewey Avenue, Rochester, N. Y.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets, Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th. and Spruce Sts., Philadelphia, Pa., 8 P. M. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Dayton—Meets first and third Wednesday at the Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 Madison Avenue, Irvington, N. J.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 1st Street. Secretary, Geo. J. Kutzen, 518 Alfred Street, Detroit, Mich.

Chicago—Meets fourth Saturday of each month at Western Building, Randolph and Michigan Aves. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Indianapolis—Meets twice a month on Friday evenings. Secretary, pro tem., J. C. Davenport, 349 Massachusetts Ave., Indianapolis, Ind.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, John G. Murphy, 71 Dingens Street, Buffalo, N. Y.

Milwaukee—Meets first Friday of each month at Eagles Hall, 137 Second Street. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Ave., Cincinnati, Ohio.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, H. H. Williams, 2134 Nebraska Ave., St. Louis, Mo.

Bridgeport—Meets on the third Friday of each month at the "Brass World" office, 260 John St., Bridgeport, Conn. Secretary, Nelson Barnard, 858 Howard Ave., Bridgeport, Conn.

Cleveland—Meets second and last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Ave., Cleveland, O.

BRANCH NEWS.

The New York branch held their monthly meeting at 258 Pearl St. The laboratory committee is making progress and will soon have things in working order. Our sixth annual banquet was a grand success and the speakers were greatly appreciated.

The regular monthly meeting of the Toronto branch was held on Feb. 25th., President J. A. Magill presiding over a good attendance. After routine business was disposed of, W. S. Barrows spoke briefly on "Specialization," and another member presented a paper on "Job Shop Routine", both of which contributions were well received.

Members of this branch have as usual, been spending their winter evenings at the Toronto Technical School, in the class devoted to them for the study of electro-chemistry as applied to electro-plating. The subjects treated so far this winter have been analysis of silver and nickel solutions, and determination of the strength of various acids, cleaning reagents, etc. With the advent of Toronto's new "Million-Dollar Tech," the branch will have a laboratory second to none, for the conducting of experimental and research work.

QUESTIONS AND ANSWERS.

Bright Dip for Copper Previous to Soldering.

Kindly give us formula for dipping solution for brightening sheet copper punchings which have oil on them from the punchings. We wish to brighten these so that we can solder them readily using rosin as flux. These parts can be immersed in melted solder if necessary.

Use the following formula for dipping copper previous to soldering:

- Water 1 qt.
- Sulphuric acid 1 gal.
- Nitric acid 1 gal.

This will leave the copper bright and clean provided, of course, it is previously freed from grease. If the copper is greasy, run through a potash or lye solution to remove the grease, as the acid will not act on a greasy surface.

Making Phosphor Copper.

What is the quickest and best way of making phosphor copper?

Phosphor copper is made by plunging sticks of phosphorus down under the surface of molten copper. For this purpose a phosphorizer is used made out of a graphite crucible mixture, obtainable from any crucible manufacturer. Details as to using this can also be obtained from crucible manufacturers. Heat it red hot before using and then allow to cool so as to anneal it. The phosphorus should be placed in the phosphorizer, the mouth being stuffed with a wad of paper to hold this in.

Dark Finish on Tin.

We wish to know if it is possible to put a uniform and permanent dark finish on roofing tin, which is subjected to a high degree of heat as well as to steam and moisture. This action causes the tin to get dark and dull, making it look old and worn after short service. We wish therefore, to give it a dark finish so that it would not show the wear and service so soon after being used.

We fear you will not be able to do this cheaply, since it cannot be oxidized like brass or copper without first plating it. You can

copper-plate and then oxidize with liver of sulphur, or put on a black lacquer, which would also give you a good finish, if this is not too expensive for your purpose.

Hardening Nickel Alloy.

What metal added to an alloy of copper 60, nickel 40, will give it a spring temper when rolled hard and yet allow it to remain non-corrosive?

Either iron or chromium will harden the nickel-copper alloy giving it the properties you mention. The addition of a few per cent of iron will not make the alloy corrode any more readily, while chromium will render it still more non-corrosive.

Spongy Castings.

We have considerable trouble in obtaining good castings from a mixture of 84 copper, 9.5 tin and 6.5 lead. These castings are spongy just under the surface. We have tried different ways of melting and remelting and have used various fluxes but are still unable to obtain good castings.

This mixture is difficult to cast unless phosphor-tin or phosphor-copper is used in it. With the addition of a small amount of either of these alloys, we believe you will have no trouble in casting. Use the following mixture.

- Copper 84
- Tin 8
- 5% Phosphor Tin 1
- Lead 6

Brass Mixture.

What is the best mixture for yellow brass castings for builder's hardware such as escutcheons?

The common mixture for yellow brass, used especially on cheap work is the following:

- Copper 66 lb.
- Zinc 31 lb.
- Lead 3 lb.

If you want a better mixture and one that has a greenish yellow color, use the following:

Copper	15 lb.
Zinc	21 lb.
Lead	3 lb.
Tin	1 lb.

If the mixture is not stiff enough, use two lb. of tin instead of one lb.

Gun Metal Finish.

Kindly inform me as to a good formula for gun metal finish on brass and zinc, also an oxidize solution on the same metals.

The best metal finish on brass is produced by first silver plating for about one-half hour, then oxidizing in hot liver of sulphur and scratch-brushing dry. Zinc is treated in the same way except that it is first plated in cyanide copper and then silver plated and oxidized. Black nickel is also sometimes used to obtain this finish, but it does not produce as good results as the oxidized silver.

Galvanizing Solution.

We wish to galvanize cast iron by the cold process. Kindly give us formula for galvanizing solution. We also require a good formula for aluminum solder.

A good electrogalvanizing solution is the following:

Water	1 gal.
Sulphate of zinc	2 lb.
Sulphate of aluminum	4 oz.

A good aluminum solder can be made from the following:

Tin	29 oz.
Zinc	11 oz.
Aluminum	1 oz.
5% phosphor-tin	1 oz.

Removing Black Scale From Brass.

I am having trouble in cleaning designed brass which has been in fire. Can you give me a solution which will clean this before buffing as I cannot remove the black by dipping in acid?

You will have to use an acid pickle to remove the black scale produced after brass has been in fire. Use a mixture of 1 part sulphuric acid to 9 parts of water. Use this solution hot and in a short time the scale will be removed, leaving the brass red. It should then be bright-dipped, giving it a uniform bright color.

Substitutes for Tin.

We have to do a considerable amount of tinning and would be glad to know if there is any substitute for tin which can be used in this operation. We mix lead in some of our pots but cannot use this on kitchen articles. We should be glad to know if aluminum has ever been used for this purpose and if aluminum will mix with tin.

If you wish to obtain a bright lustrous coating of tin, you will have to use pure tin. Only a little lead can be used without destroying the luster and of course cannot be used on kitchen articles. Other metals, such as aluminum and zinc, which might be used, greatly impair the luster, making the tin thick so that it will not run well or give a smooth coating. Pure tin is absolutely necessary to obtain best results.

Alloying Iron and Zinc.

What is the most practical way of alloying iron with zinc?

The easiest method is to heat a mixture of molten zinc and sheet iron clippings. The iron gradually dissolves in the zinc. The heat should be just below the point at which the zinc begins to vaporize and the operation will require some time. A flux or borax or charcoal used on top of the zinc will prevent its volatilization and allow a high temperature to be obtained.

AMERICAN ELECTROPLATERS' SOCIETY.

The Bridgeport branch is still forging ahead. The chemistry class, under the tutorship of Dr. F. C. Stanley, keeps up its attendance and enthusiasm well, and members feel that this excellent course will be of great practical assistance to them in their daily work. The introductory lectures have dealt with chemical terms and nomenclature, and on March 5th., the subject of electrolytic dissociation was discussed with interest. The next meeting will be held March 19th. at 260 John St., when this useful series of lectures will be continued.

A new welding-flux recently patented consists of boracic acid, iron or steel particles, furnace dross and calcined marble-dust.

THE CHEMIST AND THE BRASS FOUNDRY.*

By R. T. ROLFE, F. I. C.

PART II. BEARING METALS.

Considering next the subject of bearing metals, the foundryman is very often casting two or three types of bearing metal in the same foundry, in our case three. I suggest that it is valuable for him to know, as he sometimes does, all about the characteristics of a bearing metal, and the reasons for sometimes using one and sometimes another in engineering practice. If he does, he has a lively interest in those bearings he is casting, which interest it is impossible to have without a knowledge of what constitutes a bearing metal and why.

For example, we are casting white metal to Admiralty specification, phosphor bronze, and a lead antifriction alloy. The foundryman should know when that fairly hard metal phosphor bronze can suitably be used for bearing purposes; when it must be replaced by a softer and more plastic metal; and the advantages that Admiralty white metal has over a much cheaper metal having lead as its base.

The objection may be made that he will not be able to cast them any better for knowing this, but they will at any rate appear in a new light to him, and it is certainly necessary to have some knowledge of bearing metals to be able to appreciate that alloys of some composition, even some of those that are on the market, are not good bearing metals, and why; and the reason why a slight alteration in their composition may sometimes render them much better.

What are the characteristics of a bearing metal? When two metals in contact under pressure have relative motion between them, there is a certain friction set up, and this increases in proportion to the pressure, until a certain point is reached, after which there is a great increase in the friction, and heat is developed. In the case of hard metals, the co-efficient of friction is smaller than with soft ones, and the pressure necessary to produce that sudden increase in the friction is also greater; so that from these considerations the conclusion is formed that a bearing metal should be a hard metal, as, of course, it should. If, however, it were not only a hard, but an unyielding metal,

and there were inequalities of adjustment between the shaft and the bearing, then the shaft would be resting only on a few points, and at those points scoring would occur, with the development of considerable heat. Therefore, a bearing metal must be sufficiently plastic to make up for those inequalities of adjustment; and these qualities are obtained with a bearing metal which consists of hard grains embedded in a comparatively soft groundwork. If a soft metal, such as lead or tin, is alloyed with other metals capable of forming hard compounds able to crystallize out in the cooling mass, a bearing metal is produced.

It will be interesting to consider a few such alloys, taking first phosphor bronze. In our practice, we use an alloy consisting of 85 per cent. copper, 14.4 per cent. tin, and 0.6 per cent. phosphorus, which is obtained by mixing 85 parts of copper with 15 parts of phosphor tin. It is used for dynamo and motor bearings. In its cast state, and with the composition indicated, the structure is very similar to that of Admiralty gunmetal, and is characterised by the presence of a considerable quantity of the stannide of copper, the eutectic constituent of gunmetal. For that reason it is weaker than gunmetal, the tensile strength generally ranging between 11 and 14 tons per sq. in., with an elongation of between 1 and 10 per cent. In all cases where the proportion of phosphorus exceeds 0.2 per cent., the stannide of copper is always mixed with phosphide of copper, forming a double eutectic. The presence of the phosphide can be readily seen in the micro-section by the somewhat darker patches in the eutectic, while it is shown up much better by oxidation tinting, the phosphide turning to a dark blue, which appears black in photographing. These effects are shown in Fig 2, *a* and *b* respectively.

The ground-mass is a solid solution of tin in copper. Copper phosphide is a very hard and brittle substance, while the solid solution of tin in copper is a good deal softer than even the stannide. It is thus evident that phosphor bronze possesses the characteristics of a bearing metal, consisting of hard compounds embedded in a softer ground-mass, and as such it is used. The ground-mass, however, being a

* Paper read before the London Branch of the British Foundrymen's Association, December 18, 1914.

solid solution of tin in copper, is much harder than in the case of the true bearing metals, the lead and tin alloys, and its plasticity is therefore much inferior. There is that tendency towards scoring already mentioned. It is therefore only used where it is possible to have extreme accuracy in adjustment, *i. e.*, in dynamo or motor bearing, where also there is only an even and regular rotary motion; and for such uses it is quite suitable. Its special advantages are a low coefficient of friction, great hardness, and great resistance to wear. During that wear the softer parts of the alloy are worn away, leaving the hard phosphide in relief. Thus the wearing surface is greatly reduced, together with the friction, while the rate of wear of the

per, thus fulfilling the requirements of a good bearing metal.

For engine bearings, the most important alloys have tin for their base. The British Admiralty, for example, specifies that the proportion of antimony shall be between 8 and 9 per cent., the remainder being tin. In this alloy, only two definite compounds are formed, one a compound of tin and antimony, crystallizing in well-defined cubes, and the other a compound of tin and copper, crystallizing in hard needles, which needles often group themselves into the form of stars. These two compounds constitute the hard particles which are embedded in the soft and plastic ground-mass. The tin-antimony compound corresponds to the chemi-

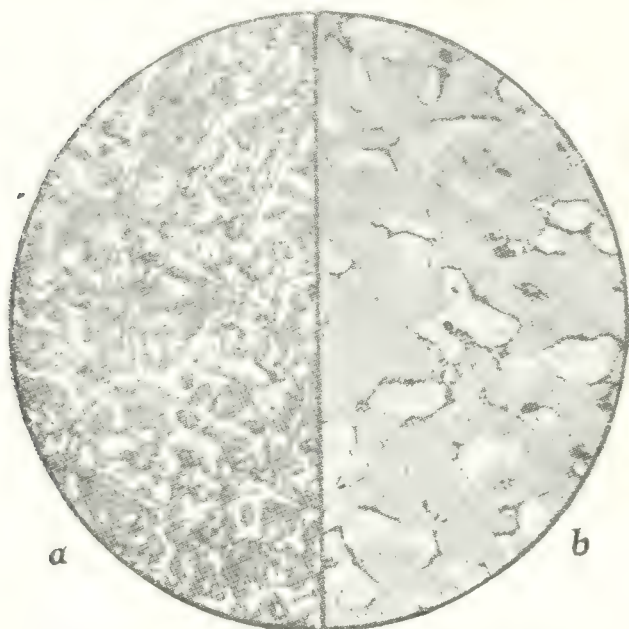


Fig. 2. Phosphor Bronze, (a) Etched and (b) Oxidation Tinted.

bearing is practically that of the hard phosphide of copper. Incidentally that is why phosphor bronze is so valuable for the manufacture of the wearing parts of machinery, and lasts much longer than ordinary bronze. On the other hand, for a long shaft supported by several bearings, where there are several different forces at work, with perhaps uneven wear, phosphor bronze would be quite unsuitable. It is not soft enough to mold itself to the shape of the shaft, and a more plastic metal, such as white metal, must be employed.

Lead is also sometimes added to phosphor bronze for bearing purposes. The resulting metal then consists of a number of very hard particles of copper phosphide and a number of soft particles of segregated lead, set in a ground-mass of solid solution of tin in cop-

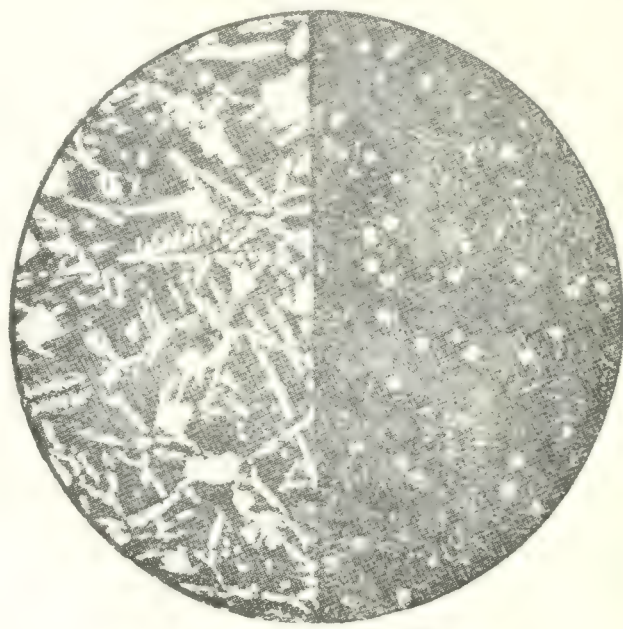


Fig. 3. Admiralty White Metal, Cu. 6.5, Sb. 8.5, Sn. 85.0. (a) Ingot Metal; (b) from Lined Bearing, Showing Size of Hard Particles Compared with Ingot Metal.

cal formula SnSb and the tin-copper compound to that of SnCu_3 . The examples shown in Fig. 3 contain about 6 per cent. of copper, and a little over 8 per cent of antimony. If the proportion of antimony be increased, the crystals of the hard tin-antimony compound become more numerous, and a harder metal is, of course, produced.

In the example, Fig. 4 a, containing instead of the 8 per cent. about 11.5 per cent. of antimony, the copper being the same, the grains, although much more numerous, are still isolated and thus transfer the load to the matrix in which they are embedded.

When, however, they become sufficiently numerous to touch one another, they bear a

portion of the load, and the alloy becomes brittle, and increasingly brittle as the amount of the plastic ground-mass diminishes. In the example Fig. 4 *b*, of an alloy containing a large proportion, some 20 per cent., of antimony, at the expense of the tin, the cubes of the tin-antimony compound are in close contact with each other. If a strain is put upon that metal, there is very little of the plastic ground-mass to take up the strain, the hard compounds slide on each other, and the metal breaks at once. It is very brittle.

It is obvious that a good deal depends upon the number and size of the hard particles occurring in a bearing metal, and although there is not time now to go into the question of the

tic, contains 87 per cent. of lead and 13 per cent. of antimony. If the antimony is present to the extent of over 13 per cent., then there are crystals of free antimony set in a ground-mass of that eutectic. If there is over 87 per cent. of lead there are similarly crystals of free lead set in a ground-mass of eutectic. So with about 16.5 per cent. of antimony there would be a certain number of hard antimony crystals quite isolated from each other under normal conditions, and set in the eutectic ground-mass.

If, however, the proportion of antimony exceeds about 20 per cent., the hard crystals become too abundant, causing the metal to become brittle. These conclusions apply if the

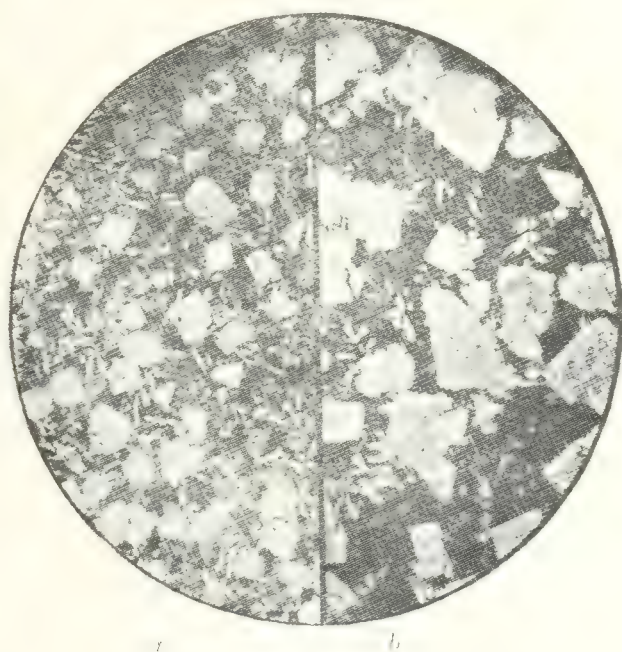


Fig. 4. Experimental White Metals.

a
Cu. 6.5.
Sb. 11.5.
Sn. 82.0.

b
Cu. 6.0.
Sb. 20.0.
Sn. 74.0.

Harder than (*a*) Fig. 3.

Very Brittle Structure.

exact sizes necessary, which sizes depend very much upon the casting conditions, it is apparent that one can tell by the microscopic examination of a bearing metal to some extent how it is going to behave in practice; and conversely, when it has failed in practice, microscopic examination will frequently indicate what is wrong.

For example, take the case of the lead-antimony alloys. A well-known brand of antifriction metal formerly contained about 16.5 per cent. of antimony, the rest being lead. Lead and antimony do not form any chemical compound with one another, but merely simple alloys. The lowest fusing point alloy, the eutec-

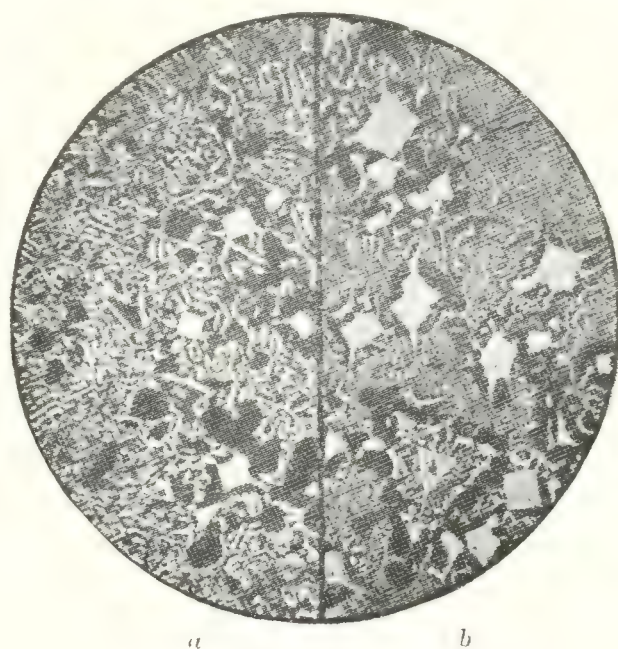


Fig. 5. Antifriction Metal, Sn. 10, Sb. 10, Pb. 80.

(*a*) Normal; (*b*) Showing Flotation of Cubes to Top of Ingot.

metal has been cast at the correct temperature, so that the antimony crystals are scattered evenly through the mass. It must be remembered that the antimony crystals are considerably lighter than the eutectic, and that therefore they will float to the top of the casting if the cooling be too slow. So that with less than 20 per cent. of antimony there is a danger of getting a brittle metal, and this occurs when the antimony may be as low as 18 per cent. The example in Fig. 6 *a* contained 18 per cent. of antimony. It was one that had broken in practice, and on microscopic examination the reason was evident. The hard crystals are in close contact with each other, giving the result one would expect.

As a matter of fact, pure lead-antimony

bearing metals are not suitable for heavy loads, although I am afraid they are still used, with very unsatisfactory results; and when it is considered that there is this flotation trouble to contend with, which trouble is far more pronounced than in the case of most other bearing metals, it is obvious that the use of these alloys should be discontinued, at any rate in all cases where the metal is subjected to heavy loads. Their rigidity is increased by the addition of either tin or copper. The addition of tin increases the rigidity and hardness of the metal without increasing its brittleness.

Although somewhat more rigid than the lead-antimony alloys, the lead-tin-antimony alloys are still not suitable for heavy loads, and they are restricted to such uses as for low-lift pump bearings. They are, of course, far cheaper than the tin-base metals.

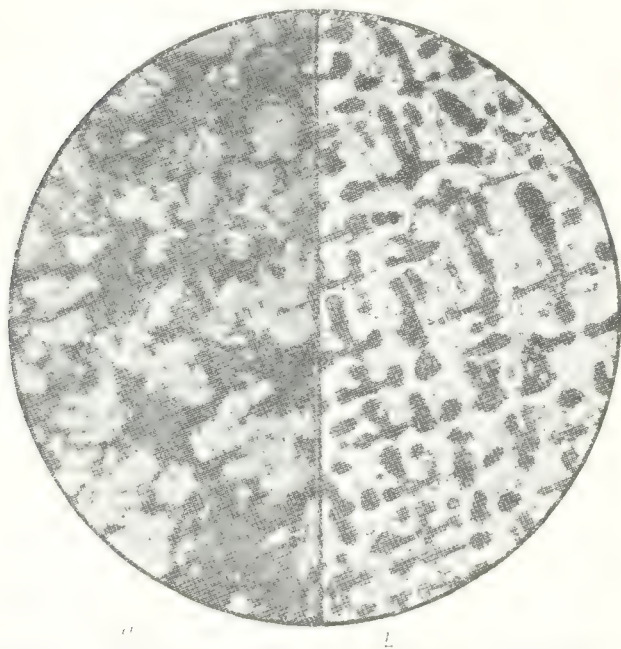


Fig. 6. (a) Alloy of 82 Lead, 18 Antimony, Showing Brittle Structure; (b) Antifriction Metal, Sn. 7, Sb. 7, Pb. 86, Showing Free Lead.

In our own practice we use a metal containing 80 per cent. of lead, 10 per cent. of tin, and 10 per cent. of antimony. The tin and antimony combine to form the usual hard compound, crystallizing in cubes (Fig. 5 a), as was seen in the case of Admiralty white metal, and these particles are set in a soft ground-mass consisting of a complex eutectic of lead, tin and antimony. It is therefore obvious that as some of the tin and antimony passes into the eutectic, unless a sufficient proportion of these metals is added, none of those hard cubes will be formed. The cubes always occur if the proportion of lead does not exceed about 81 per cent. When the proportion of lead be-

comes higher, say 85 per cent., the microstructure shows free lead, occurring often as leaf-like crystals, set in the same ground-mass as before. The alloy is still a bearing metal, consisting of soft particles of lead set in a somewhat harder ground-mass, but not such a good one.

As in the case of lead-antimony alloys, tin-lead-antimony alloys require to be cooled fairly rapidly, in order that the lead may be evenly distributed. If not, there is that same flotation of the hard compounds to the top of the cooling mass (Fig. 5 b). The question of correct temperature for lining bearings becomes thus a very important one. Care must be taken that the structure be neither too fine nor too coarse. The tendency, in alloys containing antimony, of flotation of the hard compounds to the top must be prevented by shortening the time of solidification. In general, the best results are obtained by pouring the metal at a temperature only very little higher than its solidifying point, into shells at about the temperature of 100 deg. C. (see Fig. 3b).

It might be considered that, if the best results are to be obtained by somewhat rapid cooling, by chill-casting, one would arrive at the most perfect conditions. This is, however, not so. The effect of chilling is to cause the metal to solidify so quickly that the hard compounds crystallize very minutely throughout the mass, the grain of the structure being so minute the metal can be considered as more or less homogeneous. On the other hand, too slow cooling of bearing metal causes the separation of very large crystals of the hard compounds, which in use tend to break out of the ground-mass.



TWIN POCKET-BOOKS.

You can get twin pocket-books for 100 cents, post-paid. Their names are "The Mechanical World Pocket-Book" and the "Electrical Pocket-Book. These have been produced for 28 years successively and are up-to-date reference books on all things mechanical and electrical. If you are only interested in one of the two fields, the fare is only 50 cents to the farthest zone of technical data. These useful books are issued by the Norman Remington Co., 308, N. Charles St., Baltimore, Md., and can be secured from them or from "The Brass World Book Dept."

FROM AMBER TO DYNAMO.

PART IV. THE ACTION OF ELECTROLYTES IN BATTERIES.

BY H. E. WILLMORE, Jr., B. S.

All articles in this series are copyrighted by the author.

Electroplaters throughout the country are expressing their appreciation of the value of the articles on the electric principles underlying the platers' work. Never before has any attempt been made to deal with the subject in such a fundamental way and never before have the readers had the advantage of a double force in authorship as is here presented. Mr. Willmore, Sr., is one of the best electroplaters in the United States and the author, Mr. Willmore, Jr., an expert in electrical matters, conforms his text through conference with his own father. This article is the most interesting yet presented and is a herald of better ones to come.

The theory of the conduction of electricity through solids and through electrolytes has been discussed. The electrical difference between solid conductors and electrolytes has also been pointed out:—that electrons are passed from molecule to molecule, or atom to atom, in the solid conductors, while in electrolytes the molecules split up into anions and cations, which travel with their charges. Our study of the functions of electrolytes would be incomplete without some brief mention of their action in the galvanic cell or battery.

Plating solutions may be regenerated (they may dissolve metal from the anode as it is deposited at the cathode), or they may be exhausted of their metal but using insoluble electrodes. In either case the ions are directed by a difference of potential between the electrodes. Now if it were possible to cause the plating operation to be carried on by some mechanical, heat or chemical means, we should expect to obtain a difference of potential between the electrodes by producing unlike charges upon them. Likewise if we could cause the metal of the anode to go into solution in the ionic state we would expect to find a difference of potential between the electrodes. Such action can be brought about.

About 1786 an Italian by the name of Volta was led to conclude from certain experiments which he conducted that unlike metals when in contact exhibit a difference of potential. It has since been shown that the potential differences which he observed depend upon the nature of the surfaces exposed to the air, the temperature and the chemical nature of the metals. The potential difference due to the

contact of the metals alone,—disregarding the fluid in which they are placed,—is undoubtedly of a very small order. The discoveries of Volta and his cousin Galvani, however have led directly to the development of the primary battery or galvanic cell. It has been found that a difference of potential exists between metals and electrolytes and that this difference in some cases attains a value of importance. When a strip of copper and one of zinc are placed in a dilute solution of sulphuric acid, the copper assumes a positive potential with respect to the sulphuric acid and the zinc a negative potential. The value of the difference of potential between the copper and the sulphuric acid solution is a little less than half an electrical unit (the volt) while the difference between the zinc and the acid is a little greater than half a unit. Since one is negative and the other positive, the total difference of potential between the copper and the zinc is about one electrical unit. The reason for this addition of potentials may be more clearly seen by referring again to the analogy in Fig. 8. If we let the level of B represent the potential of the copper strip, O the potential of the sulphuric acid, and the level of D the potential of the zinc, we can readily see that the difference in level between B and D is the total vertical distance between them.

Other combinations of metals and electrolytes will be found to produce other values of potential difference. For example the common sal-ammoniac cell which employs carbon and zinc electrodes in ammonium chloride has a potential of about 1.6 electrical units (volts). If the electrodes of such a cell are connected

by a conductor such as a copper wire a current will flow through the conductor. The zinc will be seen to dissolve gradually as the current continues to flow.

Since the differences of potential between metals and electrolytes is a property of the metals and solutions, one of the following conditions is necessary for the production of differences of potential external to the cell:— (1) two different electrodes must be used with a single electrolyte or (2) two electrolytes must be used with like electrodes.

The second condition is fulfilled if a solution of an acid, a base or a salt is at different densities or temperatures around the electrodes. Condition one is by far the more important although a combination of both conditions, consisting of different electrodes in two different electrolytes is sometimes employed.

We are indebted to Walter Nernst, inventor of the Nernst lamp, for a consistent explanation of the contact difference of potentials which exist between a metal and an electrolyte. This explanation is based upon the ionic hypothesis of Arrhenius. According to this ionization theory the dissolving of an acid, a base or salt in water is accompanied by a splitting up of the molecules into ions. Nernst adds to this theory the conception that a metal in certain combinations with electrolytes (such as the zinc in the preceding example of the zinc copper and sulphuric acid cell) has a tendency to go into solution in the ionic state. In other words the zinc ionizes. There is, however, a distinct difference between the ionization of a salt, acid or a base and the ionization of a metal like zinc. When the ionization of a salt, acid or base takes place, both positive and negative ions are formed carrying equal but opposite charges. The electrolyte as a whole is, therefore, neutral. In the case of zinc and sulphuric acid solution each zinc ion that is formed carries a definite positive charge into the solution, causing the electrolyte to become positively charged and leaving the zinc plate negatively charged. No negative ion is formed.

Faraday found that a very definite amount of electric charge was associated with a given amount of metal or non-metal. This means that the quantity of electricity which must pass through a silver solution in order to deposit an ounce of silver is always the same.*

Faraday also found that the same amount of

current passing for a given time would deposit weights of elements or groups of elements which are proportional to their chemical equivalents. Since some elements have more than one chemical equivalent, they also have more than one electro-chemical equivalent. Thus the quantity of electricity which will deposit 108 grams of silver (the atomic weight) will deposit about 63 grams of copper from cupric compounds or 32 grams from cuprous compounds. The above facts are known as *Faraday's Laws*.

To return to the consideration of the pressure existing between zinc and a sulphuric acid solution, we conclude from Faraday's laws that a given weight of ions of zinc going into solution carry a definite amount of electric charge. The ionization of the zinc like the ionization of a salt cannot continue indefinitely. There seems to be a definite solution pressure which tends to draw the ions into solution, until the charges held by these ions and by the zinc plate exert sufficient force to overcome the solution pressure and establish an equilibrium. The solution pressure is affected somewhat by the density of the solution and the temperature. Equilibrium in many cases is established without any apparent chemical action, because of the large quantities of electricity which the ions carry. For example, the amount of zinc which goes into solution to establish a difference of potential between the electrolyte and the zinc plate is not ponderable, because each ion of zinc carries an enormous charge.

On the other hand, we may have a combination of a metal and an electrolyte such that the tendency of the ions of the electrolyte is to leave the electrolyte. If this tendency is greater than the solution pressure which tends to hold the ions, the ions will leave the solution. This is the case with copper and a sulphuric acid solution. The hydrogen ions leave the solution, causing the copper plate to become positively charged. Another equilibrium is then established between this potential and the solution pressure.

*NOTE—It is here necessary to forewarn the plater that the ammeter does not always indicate the amount of current which is being used in depositing silver or other metals from a plating bath, because a large part of this current may be doing other service such as liberating hydrogen. It is impossible, however, to deposit more metal than is indicated by the ammeter and the time taken to make the deposit.

The copper and the zinc plates projecting from our galvanic cell are at a difference of potential, the copper being positive and the zinc negative. If these two electrodes are connected through a conductor, a current will flow from the copper to the zinc. This tends to discharge the electrodes, but as soon as a current flows the equilibrium of forces is destroyed and more zinc goes into solution and more hydrogen leaves the solution. Inside of the cell, therefore, the current flows from the zinc to the copper electrode. As soon as the external conductor is broken equilibrium is again established.

The comparative cheapness of zinc and the large difference of potential which it is possible to obtain with this metal make it a nearly ideal fuel for galvanic cells. Owing to the impurities which are ever present it is necessary in many cases to use mercury in the casting of zinc electrodes or to coat the zinc with mercury to form a zinc amalgam. The reason for doing this is readily understood. Suppose the zinc electrode contains a little foreign metal such as copper. Then if it were placed in an electrolyte such as sulphuric acid solution, a miniature short-circuited battery would be formed on the surface of the zinc, which would tend to destroy the zinc and shorten the useful life of the cell. This is known as *local action*. The mercury prevents this action to a large extent by surrounding the particles of foreign substance.

Many of the various combinations of electrolytes and metals do not give a constant difference of potential between the electrodes. The potential gradually decreases as the current continues to flow. This decrease in potential is said to be due to *polarization*. The effect is due largely to the collection of hydrogen bubbles on the positively charged plate. These bubbles disconnect a part of the plate from contact with the electrolyte. Moreover, the collection of the hydrogen around the positive pole and the oxygen or a non-metallic radicle around the negative pole may so change the combinations of potential differences that there is a difference of potential opposing the primary potential of the cell. This results in a decrease in the external potential difference of the cell. Polarization also occurs in plating solutions and the reader may have observed that it was impossible to cause any deposit from certain solutions until the applied potential difference (measured by the volt-

meter) had been raised above a certain fixed value. This is due to the fact that the plating solution exerts a counter potential which stops the flow of current until the applied potential is raised above the limit of this counter potential.

To be Continued.

EXPORT TRADE PERTAINING TO SCRAP METAL.

By THOS. ADAMS.

What will become of the metal business if we do not protect ourselves by controlling prices on our export trade? England buys metals from us at practically her own figures and we must be the victim. If we gave our manufacturers the same privilege that we accord Europe, things would be better for this country in general.

Here we have extensive refineries for the reduction of all grades of secondary metals and just because we are modern in our methods of the recovery or reduction of these metals, we must yield to the metal tyrants of Europe.

England has always been able to buy copper and brass at a lower figure than our own manufacturers, therefore, it is our duty in order to protect our own industries, to give ourselves a chance to purchase metals on the same basis that Europe does.

The smelters in this country do not get a fair show at all to dispose of their products, simply because Europe is in the market and demands metals at low prices. Then again comes the "tug of war" between the smelters and scrap dealers. The scrap-metal dealers hold their scrap at a premium, thinking every day the market will be stronger and in their favor. The result is that the smelters have to pay prices for the scrap metals, which with all the modern methods applied in the reduction, is almost prohibitive. Consequently, the smelter loses again.

Europe will be compelled to pay higher prices in the future. Take Germany today. Copper is surely scarce there. The result is that the army, like everybody else there, has to be very sparing in the use of this metal. True, we are not shipping copper to Germany, owing to the embargos that have been decreed by Norway, Sweden, Denmark, Holland, Italy and Switzerland, which comprise nearly all the gateways to Germany. Surely, the time is not far distant when the other countries out-

side of Germany will be running short of non ferrous metals. It will be necessary for us to supply them and it behooves us to maintain a price whereby we will not only realize a profit, but show Europe that we can take care of her requirements.

England wants to buy No. 1 yellow brass ingots for 9½ cents, f. o. b. New York, when that same metal will cost us 9¼ cents to make. Where do *H'E* come in? Were these ingots to be made out of virgin metals, the cost to us would be over 12 cents per lb.

Europe is very particular as to the kind of metal she purchases. In other words, they want *Something For Nothing*.

Fortunately, the price of copper is holding fairly strong but Europe is not rushing her orders. Why? Because the price does not suit them and they are waiting for a lower market, so that they can fill up. We must overcome this trouble by looking out for No. 1 first and we will not only benefit by this action but Europe will thank us in the long run.

It will not be long before we have a tin smelter, to handle South American tin concentrates. This will, to a certain extent, free us from the uncertain tin prices. This smelter will, no doubt, be located on the Pacific Coast. However, until the time for this smelter comes, we must depend on England to keep the seas open for us.

The feeling of unrest which has existed since the war started is still in evidence, but this will be overcome soon by safe and sane speculation, by applying ourselves to our own country's demands and assisting Europe only when profitable so to do.



Patchy silver deposits are generally due to the presence of sulphur, which finds its way into the solution from rubber used on racks, or in tank linings.

Boracic acid in nickel plating solutions has the effects of whitening the deposit, producing a softer deposit and eliminating the tendency to pitting.

A good covering to protect the contact of the anodes on the rod is a garden hose which has been split and then slipped over the anode rods. This can be wiped off after a batch of work has been removed. A clean anode rod means that you are getting the full benefit of every anode.—Q. R.

THE MAN, THE FACTORY AND THE POLICY.

Twenty five years ago the man, illustrated herewith, was employed by a firm using lacquer. Lacquers in those days were few and unstable. The man determined that the trade needed a lacquer of superior quality. He had the desire to serve, enthusiasm plus, credit nil and \$50 in cash. Some people would look at the cash side only and predict a very unpromising future for a business embarking with such a small financial equipment. Enthusiasm; determination, perseverance, prudence, faithfulness in the fulfillment of promises, the delivery of the goods—these won the day.



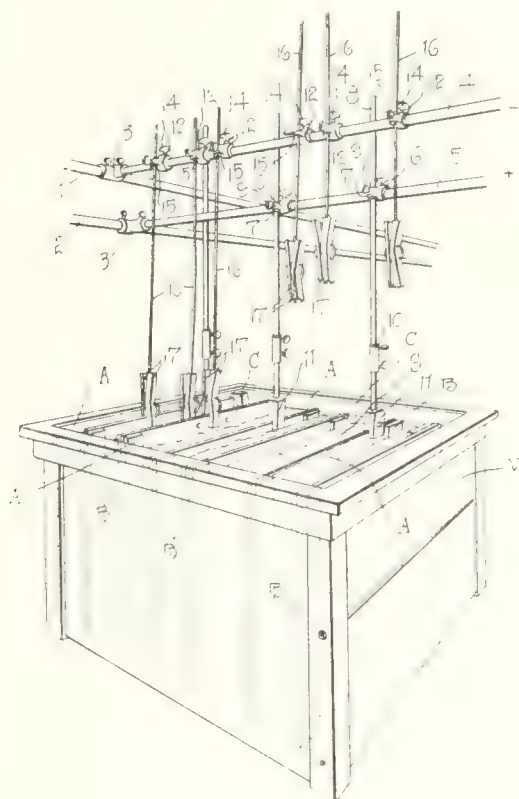
Most people using lacquers are familiar with the name of the man—G. J. Nikolas. The policy pursued during this quarter of a century has been consistent—to find out what people need, to make it for them, to treat the trade fairly and honestly and without undue discrimination.

The company has just issued a work of art entitled "The Famous Nikolas Lacquers." It is a great deal better than a catalog. It is handsomely covered in brown with gold embossed lettering. Its interior finish equals the attractive exterior. It shows a splendid factory, enduring testimony to stable business methods and gives a complete list and description of the character, purpose and methods of use of the wide range of lacquers made by the company. Other pages are devoted to an illustrated description of lacquer-spraying machinery, an ingenious device for utilizing worn-down sewed buffs and some interesting information for expert lacquerers. Every one that uses lacquer should obtain a copy of this latest artistic trade production. It can be obtained free of cost upon application. You may say the "Brass World" told you about it.

PATENT NOTES.

Electroplating Apparatus.

The object of this invention is to provide a simple and inexpensive apparatus, wherein the anodes and cathodes may be applied within or removed from the vat with convenience, and whereby the vat may be kept uncontaminated with foreign substances.



Above the vat are bus-bars having other bars connected thereto. Sleeves adjustable on these bars have rods passing through them, provided with clamping jaws to engage the cathodes in the vats.—U. S. Patent 1,129,341. Feb. 23, 1915. C. N. Smith, Elgin, Ill.

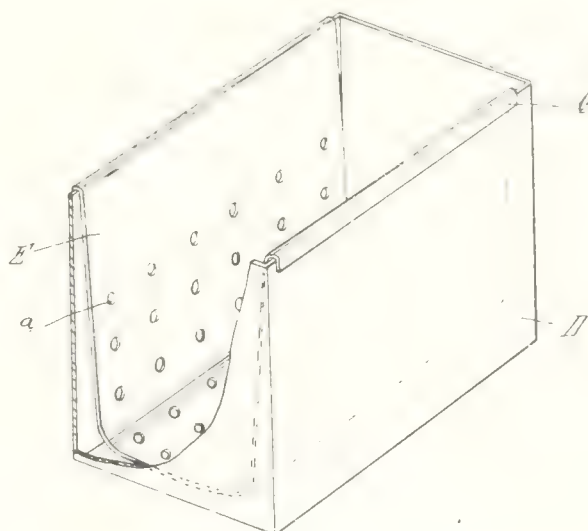
Treatment of Aluminum to Render it Unalterable.

This process of treating aluminum to render it incapable of being attacked by all external influences consists in the following: (a) treating the aluminum object with an alkaline solution, neutralizing it by acidified water and washing it with pure water; (b) then treating said object with solutions of chlorides;

(c) then treating it with an ammoniacal solution of copper chloride with addition of tartrates; (d) treating it afterward by alcoholic zinc acetate and neutralizing it by an aqueous solution of an alkaline carbonate; (e) then treating it by acidified water, washing and cleaning it carefully and heating it to a temperature above 100 deg. C.; (f) then washing the object with a hot solution of crude mineral oil, drying oils and balsams, mixed with a small proportion of gum-resins, the mixture being treated with an oxidizing agent before being used; (g) finally, completely drying the object by heat and washing it with a hot energetic alkali.—U. S. Patent 1,130,196. March 2, 1915. F. Pucillo, Genoa, Italy.

Method of Removing Tarnish from Metals.

This process for removing tarnish from metals, particularly silverware, consists in immersing the metal in a receptacle containing a mixture of carbonate of soda, bicarbonate of



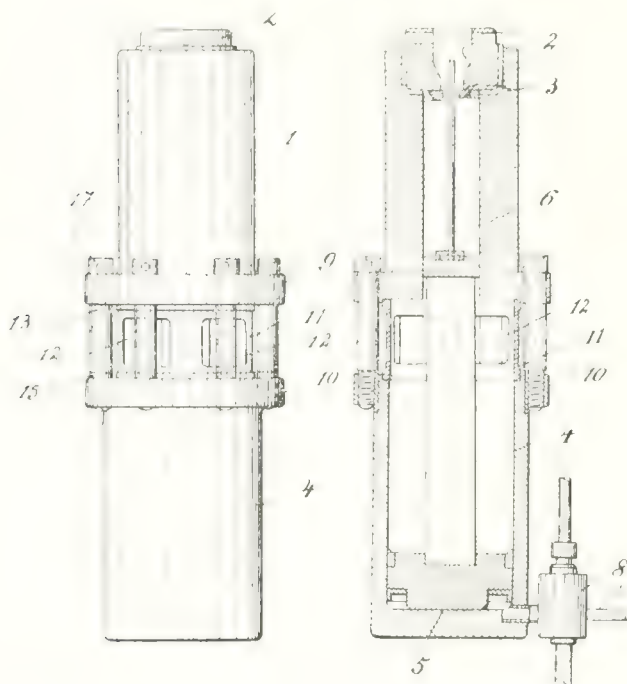
soda, and sulphate of soda, in solution, and also containing a U-shaped zinc plate, which acts as an electrode. The surface of the zinc is kept bright during the carrying out of the process.—U. S. Patent 13,880. Reissued Feb. 16, 1915. M. H. Keyt, Chicago, Ill.

Core Binder.

A material for making cores for molds consists of a composition of black stearin pitch and a reducing mineral oil such as kerosene in equal proportions, thoroughly mixed, so as to secure a composition that is liquid at normal temperatures.—U. S. Patent 1,127,523. February 9, 1915. Andrew J. Roy, Chicago, Ill.

Press for the Manufacture of Tubes from Molten Metal.

In the manufacture of tubing or wire from molten lead or other metal by extrusion, the hydraulic cylinder and the press cylinder are braced together by means of a distance piece pro-



vided with windows for inspection and for air-cooling. A piston in the hydraulic cylinder is rigidly connected with a piston in the press cylinder, which latter piston has a mandrel attached and extending through the die-orifice.—U. S. Patent 1,125,185. Jan. 25, 1915. A. Schnakenberg, Vohwinkel, Germany.

Process and Means for Securing Metallic Coats on Ceramic Surfaces.

In this process of causing metallic coats to adhere to the surfaces of porcelain, glass, terracotta, stoneware, etc., an intimate mixture is made of 5 parts linseed oil, 5 parts turpentine, oil, 250 parts bone-black, 180 parts rosin and 420 parts finely divided graphite. This is applied with a brush, and allowed to dry in the air, the coated object then being heated to 80 deg. C. in an enamelling stove. It is then

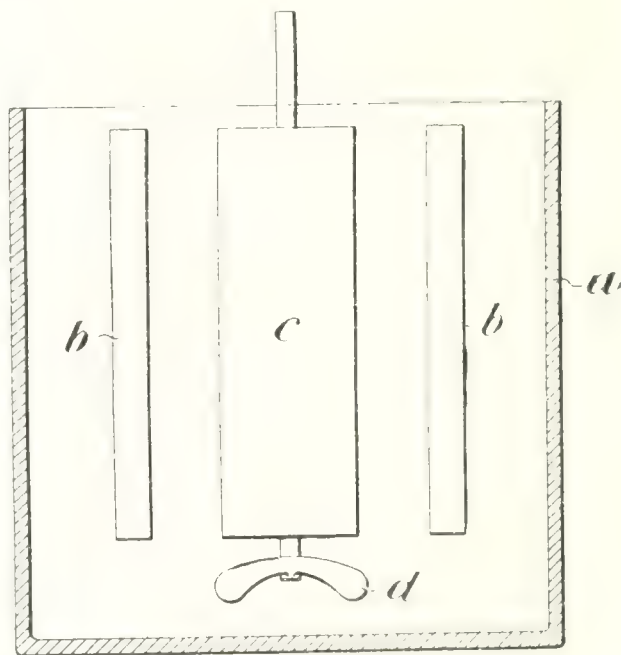
highly polished by means of a rapidly rotating fiber brush, and the metal is electrolytically deposited on this surface.—U. S. Patent 1,126,211. Jan. 26, 1915. Leo Heller, Teplitz, Austria-Hungary.

Metallurgical Process.

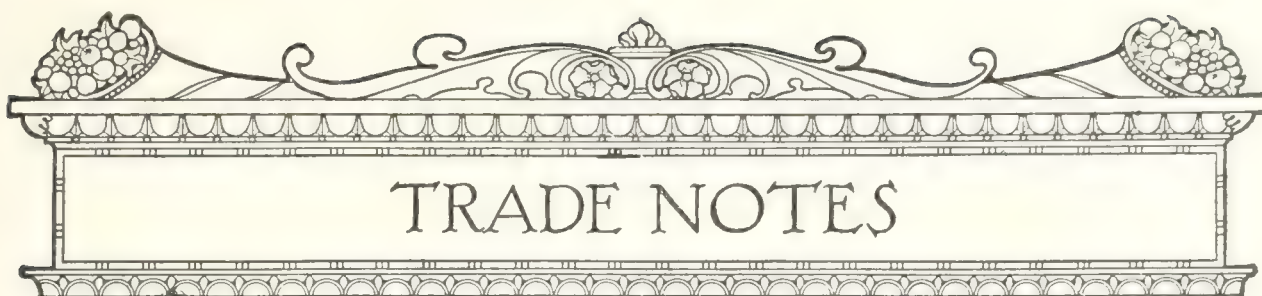
A process for obtaining radium from carnotite ore, containing vanadium, uranium, and radium, consists in first roasting the ore with sodium chloride and an oxidizing agent, then leaching with water. The radium and barium carbonates formed are dissolved in acid, and sulphuric acid is added, producing the sulphates. These are roasted with carbonaceous matter and a chloride, producing radium and barium chlorides. Fractional distillation is then employed to separate the radium chloride from the barium salt.—U. S. Patent 1,129,029. February 16, 1915. Louis F. Vogt, Washington, Pa.

Deposition of Iron.

This process for the deposition of iron, consists in adding iron sponge to the electrolyte, maintaining this sponge in suspension and distributing it through the electrolyte by agita-



tion, using a rotating cathode. This action neutralizes the acid, keeping low the amount of hydrogen produced and therefore decreasing the tendency to exfoliation and brittleness of the deposit.—U. S. Patent 1,127,966. Feb. 9, 1915. Sherard Cowper-Coles, London, England.



The Westminster Metal and Foundry Co., Hagerstown, Md., has gone into the hands of receivers.

The Bay State Metal Corporation, Brockton, Mass., has been incorporated with a capital of \$250,000 by Walton H. Atwood, James A. Roarty and H. Chabby.

The Magnus Metal Co., St. Louis, Mo., has been incorporated with a capital of \$150,000 by Fred A. Craft, A. H. Prater and L. J. Lyon.

The Alloy Metals Foundry, Belleville, Ill., has increased its capital stock from \$2,500 to \$5,000.

The Indiana Brass Works, Frankfort, Ind., recently suffered a disastrous fire which destroyed the plant. The fire is reported to have originated from a brass crucible.

The Maryland Brass & Metal Works, Baltimore, Md., is about to build a two-story brick warehouse on the west side of Guilford Ave., at the estimated cost of \$8,600.

The Rath Aluminum & Brass Foundry Co., New Philadelphia, Ohio, has been incorporated by C. J. Rath with a capital of \$40,000.

The Lake Erie Smelting & Refining Co., Cleveland, O., is about to erect a two-story addition to its plant which will be used for metallurgical and refining purposes.

The Vinita Brass Works, Vinita, Okla., has been incorporated with a capital of \$50,000 by J. F. Watkins, J. M. Jones and L. N. Ditto.

The Standard Aluminum Co., Two Rivers, Wis., has increased its capital stock from \$250,000 to \$500,000 and has purchased a warehouse near its plant.

At the annual meeting of the Florida Metal Products Co., Jacksonville, Fla., all the old officers of the company were re-elected and reports show a steady gain over preceding years.

The Detroit Brass Works, Detroit, Mich., has increased its capital stock from \$250,000 to \$400,000.

The Southern Aluminum Co. has begun the erection of a great aluminum plant at the new industrial town of Badin, N. C., to cost \$10,000,000. This plant, it is said, will produce 12,000 tons annually by electrolytic methods.

The Magnus Co., Detroit, Mich., with capital of \$100,000, has taken over the brass casting and foundry business of the National Fulton Brass Mfg. Co., 22 Brush St., Detroit, Mich. About 150 persons are employed at the plant which has a capacity of 25 tons of metal per day.

The American Zinc and Chemical Company's plant at Langeloth, near Burgettstown, Pa., is to double its capacity in the near future. The plant was completed last summer and produces 100 tons a day of sulphuric acid and operates a zinc smelter. The steady gain in demand for the products of the company has led to the demand for increased production.

The Cuba Knife Co., Cuba, N. Y., with \$25,000 capital has been incorporated by C. L. Robinson, C. A. Wheeler and H. P. Morgan for the purpose of manufacturing pocket knives, kitchen cutlery, etc.

The National Metal Weatherstrip Co. of Texas, Ft. Worth, Texas, has been incorporated with a capital of \$1,000 by R. J. Pence, W. F. Fry and E. A. Jackson.

The Maydwell Co., Inc., with offices at 408, Globe Block, Seattle, Washington, 409-411 Sheldon Building, San Francisco, California, and 822 Central Building, Los Angeles, California, has been appointed Pacific Coast representatives for the Electrical Alloy Co., Morristown, N. J.

The Metal Export Company of America, has its headquarters at 59 Pearl St., New York City and is represented in Europe by well-equipped branches. The company operates in new metals of every description and also in all special lines of manufactured goods, such as cartridge metal, brass rods, copper tubes, etc.

The Electrical Alloy Co., which manufactures resistance materials for all commercial purposes, has opened offices at 30 Church St., New York; the Bourse, Philadelphia; and Equitable Bldg., Baltimore; in charge of E. O. Oeters, who has been appointed its eastern representative.

The Roberts Brass Co., Milwaukee, Wis., has opened a factory at 249 Lake St., fully equipped for the manufacture of automobile brass specialties, railing, tubing, valves, etc.

HAND-BOOK ON SEAMLESS TUBING.

A hand-book on seamless brass and copper tubing for the use of those interested in this product—architects, engineers, superintendents and manufacturers—is being distributed by the Bridgeport Brass Co., Bridgeport, Conn. This is a handsome little work of 100 pages, neatly bound in green leather and is undoubtedly the most complete trade treatise on the subject yet presented. The methods of manufacture of seamless brass and copper tubing are explicitly told and illustrations are given of all the different processes. The book abounds in tables giving weight per foot of tubing for all gages and diameters, and useful formulas for determining collapsing pressure and essential thicknesses, and metric conversion tables. This hand-book is a complete encyclopedia on the subject and should be in possession of all those engaged in the metal industries. It can be obtained upon application to the Publicity Department of the Bridgeport Brass Co., Bridgeport, Conn.

The Wilmington Casting Co., Wilmington, Ohio, is about to build a one-story brick foundry.

The Titanium Alloy Mfg. Co., Niagara Falls, N. Y., is issuing an attractive pamphlet on titanium aluminum bronze which is quoted as "The Ultimate Bronze." An interesting introductory consideration is given of aluminum and copper alloys and of the use of titanium as a deoxidizer. Particulars concerning the properties of the titanium aluminum bronze manufactured by this company can be obtained upon application by requesting this pamphlet.

Joseph L. Dinan, president of the Philadelphia branch of the American Electroplaters' society, has affiliated with the Celluloid Zapon Co., New York City, and will represent them in New York and vicinity. He was a charter member of the Philadelphia branch and its first recording secretary, which office he held until elected president in June 1914. The Philadelphia branch wishes him success in his new venture.

MODERN METHOD OF CLEANSING METAL SURFACES.

A revised manual of information on scientific methods of cleaning metal surfaces has just been issued by James H. Rhodes & Co., 87 Front St., New York City. The product of the company is the well-known "Carlsruhe" cleanser which is made in America and has received the approbation of all trades with whom the effective cleansing of metal surfaces is important. "Carlsruhe", instead of having a caustic alkali for its active principle, has an oxide with a metal base. It refuses to unite with the grease and form a soap. Its action is to remove the grease without changing it into a soap, the grease going to the top of the solution being easily removed. The pamphlet contains useful information on effective cleaning methods on all metallic substances and of special note are the instructions given for electric cleaning. Every one interested in this subject should obtain a copy of this new booklet which can be secured upon request from the James H. Rhodes & Co. The company has a special service department under the expert management of H. G. Stevens, who has made a life study of manufacturer's and electroplater's cleansing problems and this service is at the request of all those needing it.

The Brass World & Platers' Guide

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April, 1915



A Monthly Journal Devoted to the Art of Refining, Alloying, Casting, Rolling, Founding and Electroplating of All the Non-Ferrous Metals and their Alloys

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Publishers' Announcement

Ever since the death of the late Erwin S. Sperry, the founder of the BRASS WORLD, his estate has been endeavoring to place the paper in the hands of experienced trade journalists, competent to carry it on in the same able manner as Mr. Sperry did.

Arrangements have just been completed by which this has been accomplished. G. A. Tanner and C. N. Manfred have purchased a controlling interest which includes the entire business and assets of the publication and its paid subscription list and "good will."

Mr. Tanner is well-known as the publisher of "The Hub," "Harness" and "Gas Energy," and Mr. Manfred as the publisher of "Sugar." The active management of the publication will devolve on Mr. Manfred, who will be assisted by a competent staff of editors, editorial writers and a complete organization equal to that of almost any trade journal in the country.

Mr. Manfred is already known to a number of our readers, owing to his former connection with the Ohio Brass Co. as advertising manager and later in a similar capacity with the H. W. Johns-Manville Co. of New York.

Some three years ago Mr. Manfred became the owner of "Sugar," a technical journal devoted to sugar manufacture. Under his able management, "Sugar" soon became the recognized leader in its field and it now ranks with the most successful trade journals in any line published in this country.

It is almost needless to say that with such capable management—with a complete editorial and business organization—and with ample capital behind it, the BRASS WORLD is in better shape than ever before in its history to assume its proper position as the leading publication devoted to the Metal and Plating industries.

The following letter from Mrs. Erwin S. Sperry, the widow of the founder of the BRASS WORLD is self-explanatory:—

"In view of the great personal pride and interest which my husband, Mr. Erwin S. Sperry, took in the BRASS WORLD, and the many friends among both readers and advertisers who have shown a great personal interest in the publication, I have been anxious to place it in the hands of men who I felt were fully competent to continue it along the same lines that have been so successful during my

husband's lifetime. In disposing of my interest in the publication to Messrs. G. A. Tanner and C. N. Manfred, it is with absolute confidence that the above result will be attained, and also that the paper under their management, will be made of the greatest benefit to its readers and advertisers.

As I am very much interested in the continued success of the publication, I sincerely trust that the new owners will have the same hearty co-operation from the trade generally that was formerly extended to Mr. Sperry.

(Signed) MRS. ERWIN S. SPERRY.

The new management wishes to announce that no radical departure is contemplated in the editorial policy as established by Mr. Sperry, although a number of changes will be made in the paper. These are rather such improvements as will make it more up-to-date and give our readers the best articles from both a practical and scientific standpoint, combined with all the important news of the trade.

Due announcement will be made from time to time of the proposed changes as they occur and these we believe will be of considerable interest to our readers and the trade generally.

"Keep your eye on the BRASS WORLD AND PLATERS' GUIDE."

We Move to New York

The offices of the Brass World Publishing Co. have been moved from Bridgeport, Conn., to New York City. There are several reasons for making this change; the principal ones being the better facilities offered by New York as a publishing center and the greater convenience to the publishers in keeping in close and personal touch with the trade. Many of our readers and a number of our advertisers are either located in New York or visit New York occasionally. By having our offices conveniently located in New York, we hope our many friends in the trade will make this their headquarters when in the city.

Offices occupying almost an entire floor of the Edison Building have been secured, where the facilities for publishing will be equalled by but few trade publications in the country. The Edison Building is situated at the corner of Elm and Duane Sts., being two blocks back of the City Hall and one block east of Broadway. It is within convenient reach of any part of the city, being only a block or two from the principal subway, elevated and trolley lines.

We extend a standing invitation to all of our friends in the trade to call and get acquainted when in the city. We will try and make you feel "at home," and you can receive your mail and telephone calls and write letters at our office, and make this your headquarters.

We will have something further to say about this in a later issue.

No Change in Name

Despite rumors to the contrary, circulated by an alleged "competitor" of the BRASS WORLD, we wish to state that the name of this publication—by which it has been so long identified as the leading publication in its field—will not be changed. Nor is the BRASS WORLD "enlarging its field."

The BRASS WORLD will be continued without any changes of any kind, except such improvements as may be made from month to month in its editorial makeup.

Short Talks on Rare Metals Barium

The element barium derives its name from a Greek word meaning "heavy," as all its compounds are quite weighty, although the metal itself is light, its specific gravity being 3.6, or about half that of tin. It is a bright yellow metal, and belongs to the group of alkaline earth metals which comprise calcium, strontium and barium. It is a very energetic deoxidizer and might prove of value in removing oxygen from copper and its alloys if it were more easy to obtain. At the present time the metal is obtained by the reduction of its chloride by metallic sodium. The sodium is formed into an amalgam by mercury and is then added to a hot saturated solution of barium chloride. The sodium leaves the mercury and combines with the chloride to form common salt and the liberated barium metal unites with the mercury to form barium amalgam, which is afterward washed to remove any traces of sodium, and is then heated in an atmosphere of hydrogen, to remove the mercury by volatilization. This is a somewhat roundabout and expensive way of obtaining the metal, and there is no doubt that if an extensive demand sprang up for barium, some less expensive and convenient manner of obtaining it would be developed. This is the way in which aluminum was first obtained, by the decomposition of its chloride by sodium, although in this case the sodium was not used in the form of an amalgam.

Made in this manner the cost of aluminum was prohibitive and it would have remained a very rare metal had not less expensive methods of obtaining it been discovered. The price of metallic barium made by the chloride method was about a year ago, two dollars per gram, and just now it would be very difficult if not impossible to obtain it at all. It is not likely, therefore, that this element will be used in non-ferrous metallurgy for a considerable period of time.

The Burning-In of Cores

When heavy masses of bronze are cast around comparatively small cores, the latter are very frequently entirely permeated by the metal, which under the pressure of the heads is driven into the interstices between the grains of sand of which the core is composed, with the result that it is very difficult, and sometimes impossible to clean out the cored cavity. The mingled mass of sand and metal defies even the drill, and the only sure way of cleaning out the cored hole is to chip it out while the casting is very hot, almost at a red heat.

This is a hot and difficult undertaking, one to be avoided whenever possible, and in this connection it may be mentioned that painting, spraying, or washing the core with plumbago or other blacking cannot be relied upon, as the metal when hot and in heavy mass will seep right through the blacking. The only sure way to prevent the metal eating into the core is to provide it with a coating of refractory material sufficiently thick to resist the heat and pressure of the metal. This may be accomplished by making a paste of real plumbago and molasses water, and then to rub the paste onto the core, giving it a smooth shiny coating of sufficient thickness to entirely hide the sand. After the paste has been applied the core is re-dried and is ready to be inserted in the mold. A core, coated in this manner can be relied upon to produce a clean hole in the mass of metal to which it is applied.

A good covering to protect the contact of the anodes on the rod is a garden hose which has been split and then slipped over the anode rods. This can be wiped off after a batch of work has been removed. A clean anode rod means that you are getting the full benefit of every anode.—Q. R.

FROM AMBER TO DYNAMO

Part V—Types of Batteries for Plating

By H. E. WILLMORE, JR., B. S.

All articles in this series are copyrighted by the author.

While the subject of batteries for plating is necessarily more or less technical, our many readers who have been following Mr. Willmore's article from month to month will find that he has treated this phase of the subject in a very practical manner, presenting it so clearly and concisely as to be readily understood by almost any one.

The plater occasionally is required to obtain deposits when he must look to some such source of potential as the battery. Obviously any battery which he uses must have a large current output and must give as nearly constant potential as it is possible to obtain. In other words, polarization tendencies must be small. In consideration of these points it has been thought advisable to describe a few of the cells which are adaptable to plating.

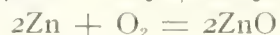
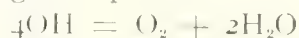
There are two general types of batteries: (1) "Primary cells," which give out electrical energy at the expense of chemical energy, and (2) "storage or secondary cells," which can be made to store up energy by passing an electric current through them. It will be seen that the storage battery stores the electrical energy given it by first converting it into chemical energy.

Probably the best heavy duty primary battery on the market to-day is the "Edison LaLande" or "Edison" primary cell. The negative electrode consists of two zinc plates placed one on each side of a positive electrode composed of compressed copper oxide, the surface of which has been reduced to metallic copper. The electrolyte is a strong solution of caustic soda or caustic potash covered with a layer of mineral oil to prevent evaporation. When the electrodes of this cell are connected through an external circuit, the potassium ions travel to the copper oxide plate and the hydroxyl ions travel to the zinc plate. After giving up their charges they react with the electrolyte and the electrodes according to the following equations:

At the positive plate



At the negative plate



These equations show that the copper oxide prevents polarization by combining with the liberated hydrogen and that the zinc is dissolved as a zincate.

Some of the limitations of the primary battery can be readily understood if we consider the quantitative results obtained in depositing a metal from a plating solution by means of a battery. The battery creates a potential which sends a current from the positive electrode through the plating solution and back to the battery by way of the negative electrode. The quantity of electric charge which deposits the metal from the plating solution and that which is associated with the dissolving of metal in the battery are identical. Furthermore, the weight of metal deposited in the one case bears a definite relation to the weight of the metal dissolved in the other case, which is the ratio of the electro-chemical equivalents of the two metals. For example, suppose silver to be deposited from a silver solution at the expense of zinc in an Edison cell. To quote from Part IV, "Faraday found that a definite amount of electric charge was associated with a given amount of metal or non-metal." Faraday also found that the weights of various metals associated with a given amount of electric charge bear simple relations to their atomic weights and these relations are represented by the valencies of those metals. We are dealing with silver and zinc, two metals whose atomic weights are roughly 108 and 66, respectively. The valency of silver is one and that of

zinc is two. Hence the quantity of electricity which will dissolve 108 grams of silver is delivered by the dissolving of 33 grams of zinc. Without taking into account the efficiency of the electrolytes of the battery and the plating bath we can see that, if batteries were used exclusively in the present-day plating rooms, the cost of zinc and battery electrolyte would be a large item. Moreover, large batteries made up of a number of cells would be required and this would mean a large first cost as well as maintenance cost. The primary battery, therefore, must be limited in its use to experimental or very small plating baths.

In cases where the continued use of batteries is advisable, such as running batches of work through the periods when the power is ordinarily shut down, or where a battery is desirable for certain classes of work, a storage battery offers the most economical source of electrical energy. This is especially true where a dynamo is also in use, because the storage battery, as the name implies, can store electrical energy from the dynamo. These cells may be looked upon as reversible plating baths. They require no fuel like zinc.

There are two general types of storage batteries in use—the lead cell and the Edison or nickel-iron cell. The Edison storage battery need only be mentioned here, because it is not as well adapted to plating as the lead storage cell. The Edison cell has a low efficiency, but it has the advantages of great mechanical strength and light weight per unit of energy output. Although its future is hardly determined, its usefulness seems to be limited to the automobile and railroad fields. The active material of the positive plate is nickel hydrate, which is held in perforated steel tubes (nick-eled), and these tubes are fastened to a heavily nickeled steel grid. The active material for the negative element is iron oxide held in rectangular pockets, also made of perforated steel. The electrolyte consists of potassium hydrate with a small amount of lithium hydrate. Pure nickel flakes are mixed with the nickel hydrate to increase the conductivity.* The average potential difference

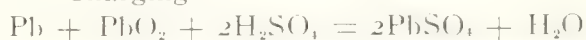
between electrodes during discharge is about 1.1 volts.

The electrodes of the lead storage cell are lead peroxide for the positive plate and sponge lead for the negative plate. The electrolyte is dilute sulphuric acid. The sulphuric acid used in storage batteries should be made from brimstone so as to avoid introducing any injurious foreign substances. The positive plate is of a dark brown color and quite hard, while the negative plate is gray and soft. This sponge lead of the negative plate, which is produced by electrolytic action, seems to be some allotropic form of lead.

There are two general methods of forming the positive plates resulting in two types of plates known as the "Plante" and the "pasted" plate. In the Plante process the lead peroxide is formed on the lead surface by electrolytic means, while in the pasted type the lead peroxide is formed into a paste and pressed into the crevices formed to hold it or is "pasted" to the lead grid.

As a lead cell discharges the lead peroxide is partly converted into lead sulphate and water. On passing a current through the cell in the opposite direction (charging) the lead sulphate is converted back into lead peroxide. The lead of the negative plate during the process of discharging the cell is partly converted into lead sulphate, which goes back to sponge lead when the cell is recharged. The above facts are sometimes expressed in the following equation:

Charging



Discharging

This equation does not tell the whole story. To carry out the idea of the migration of the ions the equations should possibly be written:

At the positive plate—

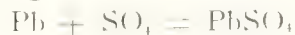
Charging



Discharging

At the negative plate

Charging



Discharging

Then we may say that the hydrogen ions of the sulphuric acid solution travel to the positive plate, give up their charges, and combine with the lead peroxide to form lead oxide and water. The lead oxide in the presence of the sulphuric acid solution is unstable and reacts with it to form lead sulphate. The sulphate

*Note—The plater should be interested in the method of producing the nickel flakes, which are about 0.00005 inch thick. These flakes are formed by mechanically plating alternate layers of copper and nickel upon large brass or copper cylinders which are first given a coat of iron to make the subsequent layers peel readily. When these cylinders have received 125 layers each of copper and nickel they are stripped and the sheet of metal is cut into sixteenth inch squares. The copper is then dissolved, leaving the flakes of nickel. The copper is recovered.

ions, on the other hand, travel to the negative plate, and being very active at the moment of losing their charges, they react with the lead to form lead sulphate. The exact changes which take place in the cell are not known, but the final result is as indicated above. It is known that lead sulphate is formed on both plates upon discharge. This tends to make both plates alike and cause a potential balance. It is also known that the specific gravity of the electrolyte is lowered upon discharging the cell and raised upon recharging. The specific gravity of the electrolyte when the battery is fully charged should be about 1.21 to 1.24, and should not fall much below 1.18 upon discharging the cell. Hydrometer readings are an excellent guide to the state of charge of the battery, if they are taken at the same temperature. (The values given above are for a temperature of 60 degrees F.) Thus, if the specific gravity at full charge was 1.240 and the next time measured was found to be 1.210, we would know that the cell was discharged to half its capacity.

The voltage of the lead cell varies from about 2 volts down to 1.7 volts during discharge. Below 1.7 volts the potential of the cell rapidly drops, due to the formation of a surface layer of lead sulphate which separates the active material and the electrolyte. Upon charging the voltage of the cell rises from about 2 to 2.5 volts.

The capacity rating of storage batteries is given in ampere-hours. This rating is usually based upon an eight-hour discharge rate. Thus a 300 ampere-hour battery will give 37.5 amperes for eight hours. If discharged at a higher rate than the normal the full rated capacity of the battery will not be obtained.

A Change in Name Only

Notice has been received of the dissolution of the International Smokeless Powder & Chemical Co., following the sale of all of its assets to the E. I. duPont de Nemours Powder Company.

The duPont Company has held a controlling interest of the International stock for about ten years past, during which time it has directed the operations of the International's factory and selling force under the same policies as have governed the other branches of the duPont Company's business.

Besides the manufacture of Smokeless

Powder, the International does an extensive chemical business and in this branch has for years made a specialty of Amyl Acetate, Refined Fusel Oil, and Soluble Cotton for lacquer manufacturers, and about two years ago extended its activities in this line to include the preparation of finished lacquers for direct sale to consumers. This chemical business will be continued under the name of duPont Chemical Works, and as no changes are to be made in the manufacturing and selling organizations that have had charge of the business to date, the only difference will be in the corporate name.

How a Brass Manufacturing Company Adopted an Economical Method for Getting Rid of an Overstock of Goods

Capital which is tied up in overstocks of finished brass goods, raw material and parts, certainly does not add to the capital turnover figures. In the manufacture of plumbers', steam, gas and water works brass goods the manufacturers of this line of goods must at all times carry a large amount of stock on some lines of these goods, as one of the stipulations on orders received is "ship at once" and the manufacturers that can deliver the goods and give the service always get the business.

Capital invested in unnecessary machinery is no worse than a surplus stock investment, although it may be more conspicuous collecting dust out in the middle of an otherwise busy manufacturing department. Perhaps it is because a good deal of money can be tied up in surplus parts, raw material and finished products, a little here and a little there, without being conspicuous, that so much capital is often thus uselessly invested. Idle machinery or an empty building may cause somebody a lot of worry and thus the evil be corrected while an overstock of parts and finished goods may, without an investigation, look entirely normal and necessary.

Every large brass manufacturing concern should have, and many do have, a department whose duty it is to study the most economical way of disposing of existing overstocks in the finished product, parts or raw materials, to devise routines that will prevent as far as possible the accumulation of overstock and the amount of stock to be carried, in fact to

study all subjects which have a bearing on the investment.

Even in the small factory where a separate department is not warranted it should be the recognized duty of some one person to watch and study conditions causing an overstock of goods in some certain lines.

One of the leading brass manufacturing concerns in the Middle West found their investment in finished products and raw material very much too high and at once proceeded to reduce it and prevent future accumulations.

Attention was first directed to the disposition, as economically as possible, of the large overstock; however, at the same time careful study was made as to the causes producing such overstock, consideration being given to means for preventing future accumulations, as far as possible or practicable.

In conducting a campaign to reduce the overstock it was of course necessary to do same at the time of annual inventory. It was found that some lines of goods had been in stock for five years and they had gone out of date or been superseded with a more up-to-date design of pattern or style. It was found that the most economical way was to dispose of them by remelting them after all parts were taken from same that could be of use on other articles.

It was also found in a number of cases that by altering the style of handles on some goods there was a slow demand for them, and by equipping them with the more modern and up-to-date features they would move off the shelves in the stock room.

As an instance of this there was a heavy overstock of a particular kind of basin cocks. It was arranged to reduce this stock by altering them. This was done by changing them from plain brass handles to china index cross handles.

In most cases of this kind (whether parts, raw materials or finished stock) it was arranged by making notations on records so that no further special attention would be given to them except possibly by those regularly engaged in specifying such parts or raw material on orders.

Before describing the methods used in preventing future accumulations, as far as possible, a few of the causes which were found to lead to over investment may be of interest. In some lines of finished brass goods incorrect prices led to unsatisfactory sales conditions, thereby causing slow sales, hence the stock did not move as fast as anticipated.

Overestimation of future sales had been the cause in some instances of overstocking on certain lines. This over-estimation may be due to incomplete or inaccurate sales records or lack of data which would show the probable tendencies upward or downward in the future, or to errors in judgment.

New designs or improvements will usually result in the older designs becoming less active. This cannot be controlled or in many cases allowed for, if the designs are those due to competitors. Other causes might be mentioned but the foregoing will illustrate why overstock will accumulate or exist in a brass manufacturing plant.

To reduce to a minimum future accumulations of stock it was found most essential to keep a very thorough record of sales to aid in estimating future demands as well as for use in making disposition of existing overstocks. A routine was introduced so that changes in design or improvements on goods were made effective until the existing stock had been reduced to a minimum or entirely used up. All old style goods were sent to the foundry and remelted and made up in to up-to-date goods.

The remelting of this old stock was a good investment, as it gave an added value due to the space made available for active goods that found a ready market. The extensiveness of the department taking care of this work would of course vary with the size of the factory. In the smaller shops this would have to be combined with other work.

It is evident from the foregoing how necessary it is that the various departments affected cooperate to get the best results. A little consideration will show that such co-operation need add but little if any to their duties.

NOTE ON LACQUERING.

Amyl acetate does not mix with water, but floats on top similar to oil, and a lacquer using this for a thinner is not easily affected by moisture while drying as a lacquer which is thinned with alcohol, acetone or other solvents which combine readily with water.

The so-called water lacquers come under the first head and the work can be put into the lacquer directly from the hot water rinse. The bottom of the tank containing this lacquer is often covered with water which has been carried in with the work, but this does not prevent the work from drying bright and clear.

W. G. Stratton.

Titanium Aluminum Bronze*

By W. M. CORSE and CHARLES VICKERS

In a number of years of practical experience in the metallurgy of alloys we have never found a more interesting combination of metals than the alloy commonly known as aluminum bronze.

The many obstacles that it presents from the foundryman's standpoint could never have been removed without extended research and able assistance from both our chemical and physical laboratories.

The solution of these difficulties has proven an intensely interesting and absorbing problem. Comparatively little is known about the action of titanium in alloys. In steel it has established itself on a firm foundation by demonstrating its value through numerous tests both theoretical and practical. The alloy field, however, was scarcely touched until Rossi began the work that became the basis on which future development was started. Rossi patented the alloys of copper, zinc, tin and aluminum with titanium as well as the combinations of various metals containing titanium as a deoxidizer.

The Titanium Alloy Mfg. Co., recognizing the field for research in alloys detailed Mr. Vickers to study the alloys of copper with particular reference to their possible improvement with titanium or its compounds. After three years of careful research, during which thousands of alloys were made, the indications of a marked improvement in the copper aluminum alloys by the addition of titanium compounds were quite conclusive.

The practical result has been the organizing of a bronze foundry specializing on titanium aluminum bronzes. Niagara Falls has scored again in the research world, and put itself one step nearer the goal which will make it the research centre of America.

Alloys of copper and aluminum were discovered over fifty years ago by Dr. Percy and their useful properties described by Mons De-

bray. The high price of aluminum at that time retarded their development and until that metal was produced by the electrolytic process not much was accomplished with them. They are well described by E. S. Sperry, founder of the BRASS WORLD, who says:

"No copper alloy held out more promise at the time it was produced commercially, and none has proved more disappointing than aluminum-bronze. After much good and bad experience with it, I will frankly say that it is a bronze without a peer, and the early 'worshippers' of it did not overrate it by any means. The lack of success has been caused by the difficulty in casting it, and not from any absence of merit in the metal itself.

* * * Unlike the tin bronzes, there is no tendency for the aluminum to separate in different alloys and liquation has never been found to interfere. It is safe to say that they are the most homogeneous of any known bronzes. Neither do they show the tendency to crystallize like the brasses or other alloys of copper containing zinc. Crystallization has never been found. They are, therefore, 'safe' alloys for construction purposes. To illustrate this point, I may say that thousands and thousands of small pins of cast aluminum bronze (10.5 per cent. aluminum) have been used by the U. S. Government in the Springfield rifle. These pins, called 'firing pins,' were used for firing the cartridges, and were employed because steel would not stand. * * *

The greatest obstacle in the way of casting aluminum bronze is its oxidation when melted. Whenever the surface of the molten metal is exposed to the air, a film of oxide of aluminum forms on it. The more it is exposed, the greater the amount. This explains why such a large amount of dross forms when aluminum bronze is being stirred. When allowed to remain at rest in a crucible, very little forms, as the surface of the metal is protected by the film already on it. It also shows why aluminum bronze should always be poured with as little stirring as possible. Any agent, such

*Paper presented before the Detroit Foundrymen's Association, Detroit, Mich., Thursday, April 8, 1915. Read by W. M. Corse.

as wet sand, which tends to stir the metal up, produces dross and the accompanying dirty castings. The more quietly aluminum bronze can be poured, the better the castings.

* * * To cast the aluminum bronze without the presence of some dross on the surface is a very difficult matter, and theoretically the right method of doing it would be to cast in a vacuum or neutral atmosphere, so that no air would come in contact with the molten metal. This, of course, is not commercially possible. The only method by which it can be cast in a commercial manner is to prevent its being agitated while the pouring is taking place, either by stirring, too high a drop from the crucible to the mould, or by wet sand. The more quietly it can be poured, the smaller the quantity of dross. Dross which forms in melting may be skimmed off, but that which forms while the pouring is taking place enters the casting. The various skim gates, pouring from the bottom, etc., are all efficacious, as they serve to trap the dross and prevent its entrance into the casting. * * * There is no addition that can be made to overcome the dross formation, nor will any flux obviate it. * * * The secret, if it may be called so, seems to lie in preventing the entrance of the dross into the casting, and not in its formation. While the presence of dross is the greatest obstacle encountered in the casting of aluminum bronze, it may be said that the shrinkage is the next. All strong metals shrink considerably, and in the case of aluminum bronze the shrinkage is equal to that of steel. * * * Shrinkage is easily taken care of if a moulder understands his business. By the use of sufficiently large risers and freedom from sharp corners in the casting, with an ample gate, any shrinkage may be readily overcome."

These properties were also reported by Messrs. Carpenter and Edwards, whose exhaustive treatise on copper and aluminum alloys presented as the eighth report to the Alloys Research Committee of the Institution of Mechanical Engineers of Great Britain and later in a paper entitled "The Production of Castings to Withstand High Pressures" before the same body, form a classic on the subject.

They summarize their work on pp. 57-60 of the report as follows:

"More than 1000 tests have been made, exclusive of about 200 specimens that have been microscopically examined and photographed.

"(a) The number of alloys that have been found of any industrial and technical promise

is small. Such alloys are chiefly those very rich in copper. At this end of the series the limit of serviceable alloys must be placed at 11 per cent. At the other end of the series the limit is even smaller. Among the specifically light alloys rich in aluminum the limit is probably not higher than 4 per cent. of copper. Between 11 and 96 per cent. of aluminum (exclusive) the alloys do not appear to be of any practical promise.

"(b) But if the range of serviceable alloys is narrow their quality is certainly high in several instances. This statement holds for certain of the rich copper alloys containing between 7 and 10 per cent. of aluminum. It is not going too far to say that in certain respects the best of them equal and even surpass high quality steels of the same general character.

"(c) Four features of the results of the tensile-stress tests of outstanding interest merit a special comment.

"(1) In view of the doubt which exists at the present time as to whether copper and its alloys possess true yield-points, it is important to record that from 0.1 to 9 per cent. of aluminum the alloys possess clearly marked yield-points.

"(2) It has been recently shown by Messrs. Stanton and Bairstow that the primitive yield-point of a rolled or forged steel is usually an artificial figure, and is due to a stiffening caused by this mechanical treatment. Such is not the case with these alloys. Their primitive yield-point is the true one.

"(3) The ductilities (considered as a product of the percentage elongation and reduction of area) of alloys containing from 0.1 to 7.35 per cent. of aluminum are very high and practically constant, even although the tenacity increases markedly with rise of aluminum.

"(4) The tenacity and ductility of the widely known 'aluminum bronze' or 'gold,' containing 10 per cent. of aluminum, have been found to be as good in the form of small chill castings as in the rolled bar, where an 80 per cent. reduction of area of the original ingot has been effected. So far as the authors have been able to learn, this result has no parallel. At their request therefore independent tests were instituted at the Broughton Copper Works, and these have confirmed the above result, which may have important practical consequences.

"(d) The research has brought to light several striking instances of the profound influence of a small quantity of aluminum upon

copper, notably in the tension tests, but especially in the torsion and electrical conductivity experiments. One-tenth of 1 per cent. raises the angle of twist of copper in torsion 90 per cent.; it lowers the electrical conductivity 23 per cent.

"(e) The behaviour in torsional stress of the alloys containing from 0.1 to 7.35 per cent. of aluminum is one of the outstanding features of the Report.

"(f) The alloys containing from 5 to 10 per cent. of aluminum have come well out of the dynamic-stress tests. The particular merit of alloys No. 9 (7.35 per cent. aluminum) and No. 13 (9.90 per cent. aluminum) when tested in alternating stress is the close approximation of the maximum stress under which they will bear an unlimited number of reversals to the stress at the elastic limit as determined in a tensile test. In this respect they are markedly superior to the iron and steel specimens hitherto investigated.

"Alloys No. 6 (5.07 per cent. aluminum), No. 9 (7.35 per cent. aluminum), and No. 13 (9.90 per cent. aluminum) stood up well when repeatedly stressed beyond the yield-point in Arnold's test. In fact Professor Arnold has informed the authors that 'Alloy No. 9 constitutes a record in its capacity of resisting alternations.'

"(g) At about 15 per cent. of aluminum the alloys are entitled to rank with quenched steels in hardness. Thus the hardness number of No. 17 (15.38 per cent.) in the cast state (untreated) is 539, which is about that of a 0.45 per cent. carbon steel quenched in water at 20 deg. C. (68 deg. F.), and is only slightly lower than that of a 0.66 per cent. carbon steel similarly treated.

"(h) In the corrosion tests, which were purposely made as severe as possible, alloys containing from 1 to 10 per cent. of aluminum have shown themselves to be practically incorrodible by sea-water, whether alone or bolted to a plate of mild steel. In these tests they showed themselves superior both to Muntz Metal and Naval Brass, which corroded appreciably. In tap water of medium temporary hardness the positions were exactly reversed.

"(I) Finally, a special comment must be made on the truly extraordinary similarity in physical and mechanical qualities between Alloy No. 13, which consists of 90.06 per cent. of copper + 9.90 per cent. of aluminum and Swedish Bessemer rolled steel of about 0.35 per cent. of carbon and .38 tons

per square inch ultimate tensile stress."

With such a wealth of data available on these alloys it is natural that interest in them should be aroused in the foundry. Practical commercial work has conclusively shown, however, that the difficulties of casting are very great. As Sperry says the lack of success has been caused by the difficulty in casting it, and not from any lack of merit of the metal itself.

When titanium compounds are added to aluminum bronze their action seems to be similar to that in steel, viz:—the removal of oxides and reduction of segregation. As the presence of oxide of aluminum is very detrimental in any alloy and as dissolved oxygen and nitrogen should be removed, this action of titanium is of great advantage.

The practical results of the application of this theory has been to make possible the commercial production of small and large titanium aluminum bronze castings with no more than the normal percentage of foundry loss.

This does not mean that any of the precautions noted can be neglected. In fact no alloy that we have used requires more care and supervision.

The results, however, fully justify the exercise of care, for castings of clean titanium aluminum bronze certainly warrant Professor Thurston's opinion:

"It works well, casts well, holds a fine surface under the tool, and when exposed to the weather; and it is, in every respect, considered the best bronze yet known."

St. Louis Foundrymen Elect Officers

The St. Louis Foundrymen's Club held its regular meeting on March 13th at which it elected its officers for the year 1915-1916. The meeting was held at the Marquette Hotel. The following officers were elected for the ensuing year:

President: H. S. Gulick, More-James Brass & Metal Co., St. Louis.

Vice-President: H. G. Smith, Washington University, Mechanical Engineering Dept., St. Louis, Mo.

Treasurer: W. G. Roepke, Commonwealth Steel Company, St. Louis.

Secretary: C. Roy Rook, U. S. Incandescent Lamp Co., St. Louis.

This club is devoted to the interest of the St. Louis foundrymen and meets at the Marquette Hotel on the second Saturday of each month. All foundrymen are invited to attend.

TREATMENT OF STOVE CASTINGS PREPARATORY TO PLATING

By HARRY E. STARRETT*

(Continued from page 108, March, 1915)

There is probably no line of polishing that differs more widely in the manner of operation, than the finishing of stove trimmings for plating. This can be briefly explained as follows:

In the preceding article the writer has out-

the castings reach the polishers' hands, however, there is another division of operation which is followed out to produce the different grades of finishes required, and which, if described fully, would be an endless story. It will therefore be necessary to treat this sub-



Partial View of the Plating Room.

lined the reason for the different methods being employed in stove shops on account of the castings used and their methods of making them. The difference is small when it starts in the foundry. It does not enlarge very much by change of pickling methods. When

subject very much as the writer did the pickling and if possible, introduce a composite line of directions in which a general method of polishing employed can be outlined.

The stove manufacturers doing their own plating turn out a great many classes of goods. For instance, the large stove companies located in Detroit, and other large stove makers in the

* Western Sales Manager of Hanson & Van Winkle Co., Newark, N. J.

west, manufacture a great many base burners. These stoves are mounted with the highest grade of nickel trimmings that can be produced. These companies also make a line of high-grade ranges on which the trimmings are finished fully as well as those mounted on the base burners.

There are other companies who make a good line of stoves but do not aim to meet this high-grade of finish and in consequence a cheaper finish is used on the trimmings.

The third class of manufacturers confine

roughing. Some of the less progressive use paper wheels, or a hard canvas wheel made of sail cloth, with discs glued together. The more modern and up to date companies, however, use the Union Canvas, the Rival, or the Universal wheels for roughing.

The dry-fining operation is similar to the roughing, with the exception that a finer emery is used. In roughing, the wheel is run over the article in one direction. In fining the wheel is run cross-wise over the roughing operation, which takes out the roughing



A Corner in the Buffing Room.

themselves to what is known as a cheap line of stoves, where the expense is reduced on the finish as low as possible, consistent with the sale of the goods. We will therefore divide the operations into three classes, calling the base burners, the high-grade work, a five-wheel operation, the medium grade of work, a four-wheel operation and the cheaper work a three-wheel operation.

The five operations in the first class consist of roughing, dry-finishing, second fining, oiling or greasing, and finishing. Different wheels are employed by different companies for

scratches and when possible, in the second fining, the direction of the wheel should run diagonally across the two preceding operations.

The emery used on fining is generally two grades finer than the roughing. The emery used in the second fining work is one or two sizes less than used on the first fining wheel.

The character of wheel used for oiling or greasing varies. Some of the stove companies employ the Union Canvas Wheel with excelsizes less than used on the first fining wheel. The Bullneck and Felt Wheel, however, are in more general use. With most companies the

grease wheels are set up with emery ranging from 120 to 180 and then worn down by running it over a few pieces of work. Emery cake, crocus, tripoli or tallowene is then applied to the surface of the wheel on which the work is polished, for the greasing operation. The direction of the wheel over the work in this operation is optional. If any of the roughing scratches still appear, it would be well to run the wheel cross-ways of the direction used in roughing; but if the preceding operations are properly done there should be no deep scratches left for the grease wheel to take out.

When the grease wheel clogs up, lump pumice stone is applied to clean it out, and what is termed, "liven" it.

The finishing wheel is the last operation. A well-worn grease wheel is generally used for this purpose, the wheel itself being nearly always of felt. The operation differs from greasing, from the fact that a very hard flint stone is worked over the grease wheel, giving a high polish to the surface. When the work passes over this it brings out a lustre, wears down any semblance of scratches in former operations and leaves a high grade finish. The higher the polish secured on the casting the better nickel finish can be produced. The writer will show in his directions on buffing that methods can be employed that will eliminate considerable polishing, if buffing is properly done.

The second grade, or four-wheel work, is done similarly to the first, with the exception that the second fining or finishing is omitted. In some shops the work runs first over roughing, then fining and then second fining, while other places they rough out, fine, grease and finish. The first procedure is preferable from the fact that more scratches are taken out of the work by this method and with the modern methods of buffing a high finish can be obtained on the work where the grease wheel is used and the finishing wheel eliminated.

The third, or cheap grade of work, is done on two or three wheels, generally three, comprising roughing, dry-fining and oiling or greasing. The number of emery used does not change materially in the three grades of work, simply the elimination of some intermediate size. For illustration: The steps in the first grade of work might be: No. 60 for roughing; No. 90 for fining; No. 100 for second fining; No. 120 to No. 150 for oiling; No. 150 to No. 180 for finishing.

The second class or four-wheel would be:

No. 60 for roughing; No. 100 for fining; No. 100 to No. 120 for the next operation; No. 120 to No. 150 for the final operation; regardless of whether oil or finishing wheel is used.

The last operation is generally: No. 60 for roughing; No. 100 to No. 120 for fining; No. 120 to No. 150 for oiling or greasing.

Nearly all text books give detailed description of what these different wheels are and how they are set up ready for operation. The writer will therefore omit going into detail on this point and will next take up briefly the equipment best to use in the polishing room of a stove foundry.

(To be continued.)

DESCRIPTION OF ILLUSTRATIONS

The illustrations in the article portray the polishing room, cleaning room and plating room of the Cribben & Sexton Co., Chicago, all contained in one large building, partitioned off to meet the exigencies of effective operation. The work is conveyed from one room to another by dolly trucks. The tanks are maintained in continuous operation.

The illustration of the cleaning and preparation room shows two tanks equipped with overhead hoods devoted to electric cleaning.

A few of the nickel plating tanks partially reveal two motor generator sets from which 1,000 amperes are secured for electric cleaning and 2,500 amperes for the regular plating work.

It can be noted by careful study of the illustration that the wiring system is particularly efficient. In the installation nearly a ton of copper wire was saved. The line of tanks is supplied from its center, splitting 1250 amperes each way. There are 10 tanks holding approximately 900 gallons of nickel plating solution each. The plant was equipped by the Hanson & Van Winkle Co., Chicago.

The tanks are equipped in the usual manner with longitudinal anode and cathode rods. Each tank at one end is equipped with two upright insulated cast-iron standards which support the main leads of flat copper bars.

These copper bars are 3 in. by $\frac{1}{4}$ in. and run from tank to tank forming perfect conduction for current supply with least possible loss.

All tanks are connected in multiple from these overhead leads by branch arms of flat copper, 1 in. by $\frac{1}{4}$ in., instead of being con-

needed in ordinary manner by thumb screw connection and flat bar.

The bars are drilled and tapped and connection made by machine bolt, obviating all risk of loss by contact.

The rheostats are also mounted on upright insulated cast-iron beams. Being surrounded by free air, there is no trouble to be anticipated from overheating, burning or catching fire. The best efficiency thus given to the rheostat enables the operator to have most complete control over his voltage.

The voltmeter and ammeter are so installed that reading can be obtained or taken from the entire group of tanks, from any one tank, or from any one piece in any tank.

Most of the tanks are built of concrete and clear fir lumber. The corners of the tanks are reinforced in a substantial way by having a triangular filler of asphalt, an upright strip forming the triangle and the asphalt being set in this triangular box. The tank is then lined in the usual way, but the strength of corner reinforcement practically eliminates all risk of leakage. The concrete tanks are used for the electric cleaner. The electric cleaner is used as an auxiliary for all special cleaning work, each class of work receiving such treatment by scrubbing and electric cleaning as has been demonstrated to be necessary by constant practice.

The buffing is done almost entirely on specially made stitched cloth buffing wheels 16 in. in diameter. The polishing room is kept perfectly ventilated by proper fan installations and exhaust ducts. In all the nickel plating a standard formula is used of double and single nickel salts. The foreman plater in charge of the entire work is Frederick Schmidt, who has for a great many years been engaged in the business and connected with the company.

A new aluminum alloy patented by Alfred Wilm, Berlin, Germany, (U. S. Patent 1,130,785), consists of 95.5 per cent aluminum, 0.5 per cent magnesium, 3 per cent copper and 1 per cent manganese.

Genuine babbitt when properly made has a low melting point, is easily worked, has good anti-frictional qualities and will stand a large amount of careless handling.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES.

New York—Meets fourth Friday of each month at Broadway Central Hotel, New York City, at 8 P. M. Secretary, Joseph Minges, 148 Schenck Avenue, Brooklyn, N. Y.

Rochester—Meets second Friday of each month at Hotel Rochester. Secretary, C. V. Haring, 306 Dewey Avenue, Rochester, N. Y.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa. Secretary, Philip Uhl, 2132 North 29th Street, Philadelphia, Pa.

Dayton—Meets first and third Wednesday at the Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 Madison Avenue, Irvington, N. J.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 1st Street. Secretary, Geo. J. Kutzen, 518 Alfred Street, Detroit, Mich.

Chicago—Meets fourth Saturday of each month at Western Building, Randolph and Michigan Aves. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Indianapolis—Meets twice a month on Friday evenings. Secretary, pro tem., J. C. Davenport, 349 Massachusetts Ave., Indianapolis, Ind.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, John G. Murphy, 71 Dingens Street, Buffalo, N. Y.

Milwaukee—Meets first Friday of each month at Eagles Hall, 137 Second Street. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Ave., Cincinnati, Ohio.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, H. H. Williams, 2134 Nebraska Ave., St. Louis, Mo.

Bridgeport—Meets on the third Friday of each month at 260 John St., Bridgeport, Conn. Secretary, Nelson Barnard, 858 Howard Ave., Bridgeport, Conn.

Cleveland—Meets second and last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Ave., Cleveland, O.

The semi-annual meeting of the Cleveland Branch was held on Saturday evening, March 13th, at the Central Y. M. C. A. Interesting papers were read by Messrs. Ter Doest and W. D. Scott which will appear in due course in the "Monthly Review." Mr. Ter Doest exhibited samples of 30 different finishes, 3 to 5 finishes on a plate, which were greatly admired. Other members also brought individual samples which aroused comment and caused discussion as to the manner of their production.

The Cleveland Branch is progressing steadily and has a good live secretary, Charles Werft. At the recent meeting of the Cleveland Branch, a distinguished visitor was the Rt. Hon. Arthur J. MacDermid of the J. B. Ford Co., Wyandotte, Mich. Friend MacDermid has just recovered from a long siege in the hospital and the attending weeks of convalescence. The doctors thought he knew too much and took away his appendix. He interested the Cleveland members by an address, his subject being, "The Possibilities of Branch Development." Plans for the gigantic smoker at Cleveland are being made and the committee on entertainment reports progress. The probable date will be April 30th and actual details and final data will be published in our next issue.

The New York Branch of American Electro-Platers' Society is now comfortably installed in its new quarters in the U. S. Arcade Bldg., 262 Pearl St., New York City. The meetings are now held on the second and fourth Fridays of each month. Visitors from out of town and outlying districts of New York can reach the meeting room easily by taking a subway to Fulton St. and walking four blocks to the corner of Pearl and Fulton streets. The room numbers of the society's headquarters are 11 and 12 in the U. S. Arcade Building.

The March meeting of the Toronto Branch was held on the 25th and provided another very interesting evening. A good turnout of the members and some lively discussions on plating subjects in general being thoroughly enjoyed by all.

On April 22nd, this branch will keep open house and any person interested in any way in the Electro-deposition of Metals will be welcomed at our meeting room in the Occidental Hall, corner Queen and Bathurst streets at 8 P. M. A very interesting program is being compiled and an enjoyable and profitable

evening is anticipated. One of the items will be "The Action of an Acid Copper Solution," illustrated by means of a projecting lantern through a glass tank, and the actual action will be shown on the screen. This subject alone should be well worth seeing and hearing.

Other papers on electro-deposition have been promised by capable speakers who are besides practical men. A few musical and vocal selections of the usual high quality shown at past open meetings of Toronto Branch should add to the success of the meeting.

American Foundrymen's Association

The annual meeting of the American Foundrymen's Association will be held at Atlantic City during the week of Sept. 27, with headquarters at the Marlborough-Blenheim hotel. Business and technical sessions will be conducted on Young's steel pier, almost directly opposite the Marlborough-Blenheim. The exhibit of foundry equipment and supplies under the auspices of the Foundry & Machine Exhibition Co., will be held on the steel pier and will open Saturday, Sept. 25. A tentative program of the meeting already has been adopted, as follows:

Monday, Sept. 27.

Registration.

(Headquarters Young's steel pier.)

Tuesday, Sept. 28.

10:00 a. m. Opening session, joint meeting between the American Foundrymen's Association and the American Institute of Metals.

2:00 p. m. Operating session.

Wednesday, Sept. 29.

10:00 a. m. General session.

2:00 p. m. Gray iron session.

8:00 p. m. Business session, annual address by president, election of officers, etc.

Thursday, Sept. 30.

10:00 a. m. Simultaneous sessions on steel and malleable iron.

2:00 p. m. Simultaneous sessions on steel and malleable iron.

7:00 p. m. Annual banquet.

Friday, Oct. 1.

10:00 a. m. Final business session.

It will be noted that this tentative program provides for two sessions for the discussion of cast steel and two meetings will be devoted to malleable iron. At our last meeting, held

at Chicago, insufficient time was allotted for the discussion of the many valuable papers presented and to enable those who are interested in these topics to discuss the papers at length, two sessions will be devoted to steel and malleable, respectively. The change in the session at which officers are elected was effected for the purpose of giving the new officers an opportunity to meet prior to the close of the convention for the purpose of outlining the ensuing year's work.

The papers committee already is actively at work on the program obtaining contributions and any member desiring special topics discussed should send his suggestions either to the secretary or to Harry B. Swan, chairman of the papers committee, Cadillac Motor Car Co., Detroit. The committees appointed at our last annual meeting also are at work and many interesting and valuable reports will be presented at the Atlantic City meeting.

Revision of Constitution and By-Laws.

The proposed revision of the constitution and by-laws, passed to letter ballot at our Chicago meeting has been favorably acted upon, 103 ballots having been cast in favor of the revision and 3 against. The revised constitution and by-laws appear in the year book and the principal changes provide for an entrance fee after May 1, 1915, of \$10 for active members and \$5 for associate members.

Associate Members

The Associated Foundry Foremen have given up their charter and all of the members in good standing are now affiliated with the American Foundrymen's Association as associate members. The total number added to the enrollment is 102, thereby increasing the total membership of the society to nearly 1,000, the highest mark attained since its organization.

The Society Emblem

In view of the fact that no emblem of the society was ever officially adopted, President R. A. Bull appointed an emblem committee immediately following the convention, which consisted of A. O. Backert, Cleveland, chairman; Thomas D. West, Benjamin D. Fuller, H. Cole Estep and R. A. Bull, president (ex officio). Numerous designs were prepared and submitted for consideration, resulting in the adoption of the emblem appearing at the top of the first page of this pamphlet. Also, it was decided to reproduce this emblem in the form of a button and these now are avail-

able to the members in gold and black enamel at a price of \$2 each. The buttons are exceedingly handsome and every member of the society should avail himself of the opportunity of obtaining this insignia of affiliation with the world's greatest technical foundry organization. These buttons can be obtained by addressing the secretary, A. O. Backert, Twelfth and Chestnut streets, Cleveland, O.

Economy in the Management of a Plating Department

By E. S. THOMPSON.

In these days of industrial stagnation we often hear manufacturers remark that they will be compelled to retrench, and this retrenchment usually starts by lopping off some of the high salaried men. This is particularly true of the foremen of the plating departments. It seems that plating is being regarded as a very simple process, that a few formulas, a fair equipment and a book on plating are all that is necessary for a boy to have in order to turn out the work.

But do they take into consideration the fact that the *fewer* orders they have the *more* they need efficient help that they may increase the orders? Let's see: A certain manufacturer was paying his foreman plater \$30 per week. The tank man received \$15 per week. Three polishers received an average of \$60 per week. This is a total of \$105 per week for labor. The supplies for 1500 gals. of solutions, including cyanide copper, bronze, brass, silver, nickel the various dips for finishes and cleaning, did not exceed \$7 per week. (This does not include anodes.) This brings the total up to \$112 per week for labor and supplies.

The superintendent decides that there is no need for a foreman plater under present conditions, and further decides that as he has not so much business to look after as formerly he can place the tank man in charge of the plating room and give him a boy to help him, thus cutting down the overhead expense. But does he do that? We will see.

His foreman plater had made a life study of electro plating and had his processes figured to the highest efficiency. He had studied chemistry, going deep into its secrets, and knew what he was doing. He had eliminated the necessity for scrubbing and had long ago dispensed with the help which had been required for that purpose. He had discovered

that the electric current must be figured as an element and that a certain percentage of unsaturated water must be present in his solutions to get the best results. He had discovered the cause of "peeling," "burning," "pitting," "spotting out," "streaking," and the innumerable defects of electro deposits and had remedied all this.

Now this plater was an electrochemist and the superintendent, while being a very efficient man as a superintendent, knew nothing of electroplating. Neither did the man who had been doing the actual plating except to follow out the instructions of the men who did know. The first week of plating under the new conditions gave the superintendent very pleasing results. The plated work seemed to be coming out as good as ever. A boy had been hired for \$9 per week and \$21 per week had been saved in the plating department alone. That was quite an item for a small place.

But the second week? Ah, there comes a story. The solutions had changed under the tension of rush orders and were beginning to behave differently. Considerable work was being repolished and replated. The brass and bronze were off color. The nickel was pitted and did not have the silvery appearance as formerly. All the cyanide, the copper salt, the nickel salt and the supplies which had usually lasted three months had disappeared and more were ordered. The finished stock was showing discolorations and was unfit for sale. So much work had to be refinished that at the end of the fourth week it was necessary to hire another polisher, also another boy for the plating room and not one dollar more had been added to the sales sheet and customers were beginning to complain of the appearance of their goods. Also, conditions were growing worse.

Now, the former cost per week had been \$112. The cost for the fifth week under the new order of things was \$113 for labor and an average of \$20 per week for supplies, and practically no work produced which was salable. Where was the economy?

It takes a man with chemical knowledge, executive ability and some confidence in himself to operate a plating-room economically. It is necessary at times to point out to the superintendent the necessity of rerouting the work through the factory. Some superintendents object to the man under him making any suggestions for changes in other departments, but these superintendents are the ones

who usually lose out in the long run and it is better for the plater to be fired for *trying* to get the work out right than to be dismissed for inefficiency.

The American Electroplaters' Society is making rapid strides toward overcoming all the difficulties encountered in the plating room. Many of its members are poring over books, figuring equations, putting two and two together and digging deep into theories which are almost forgotten. Some of its members have solved the problem of *why* the deposition of metal takes place and have worked out formulas which give an equilibrium. Are we to understand that some manufacturers do not want knowledge? Must we believe that there are yet those who think they can meet competition with inefficient help while their competitors are saving the dollars which they have thrown away? The next year will tell the tale. We will see whether it is labor plus knowledge that counts in the plating department or whether it is labor minus knowledge which is desired.

Furnace Practice in the Brass Foundry

By R. MICKS

In the majority of brass foundries the melting end of the business seems to receive less attention than any other part of the foundry, when in fact it is the most important part in the production of brass castings. The result of this condition is that 90 per cent of the brass founder's troubles can be traced to the fact that the metal has not received proper care during the process of melting.

A good, reliable, intelligent furnace man is one of the most essential requisites to make a brass foundry a success and a good man in this position, even if he is high-priced, is the cheap man in the end, for no matter how perfect your molds are constructed they will count for nothing unless the metal is carefully melted and the proper flux used on it.

Porosity, dross and other defects in brass castings can generally be traced to carelessness in the melting, for if the copper or other metals are simply charged in the crucible, and allowed to melt any old way, more dross or oxide will be formed than if the melter had assisted the charge to settle down in the pot as it melted, and kept it covered with charcoal. The defects in these castings are not always visible to the naked eye, but

when put under pressure will leak and as these castings are nearly all polished, it causes a great waste of time and material.

In melting copper great care should be taken to keep the metal well covered with charcoal, as copper has an affinity for oxygen and it is a very difficult proposition to make solid castings of copper alone; however if the melter gives the metal the proper attention and the right flux or deoxidizing agents are used, it is possible to secure good, sound castings, and for the best results the ingot metal should be 99.6 per cent pure copper. Boron Sub-Oxide is now generally acknowledged to be the best flux for copper, while potassium ferro cyanide also gives good results, and some founders prefer to use deoxidizing agents such as silicon-copper, magnesium, phosphorus, etc., all of which work out to advantage with copper.

In melting copper for brass or bronze the proposition is different from the preceding one and as a flux for this purpose, nothing is better than common salt. It should be added just after the copper begins to melt. A handful to an ordinary crucible will be sufficient. Its action will then form a protective coating on the metal and prevent the oxide of copper from forming. Care should be taken not to raise the temperature any higher than is necessary when melting copper, as the higher the temperature, the more gases and oxide will be formed. If, however, the copper becomes overheated it can be brought back by the addition of tin or phosphorus.

In melting brass or bronze the same rules will apply as in melting copper and for a flux, salt should be used in the same manner as described in the melting of copper for brass or bronze, a handful to a crucible.

When melting aluminum, a crucible that has been used for a couple of heats for melting copper or bronze will give better results than a new one, as the melting point of aluminum is not high enough to harden the pot and it wears away, especially at the top where the furnace tools come in contact with it. Aluminum should be watched very closely in the melting and not be overheated, and should also be protected from contact with the air as much as possible as it oxidizes when it comes in contact with it, forming a thin film of aluminum oxide on the surface of the molten metal, which may spoil the casting if allowed to pass into the mold. The cold material should be added before the

first charge is completely melted in order that it may become heated before descending into the liquid metal at the bottom of the pot. This should be continued until the crucible is full but no more cold metal should be added than the melted stock will dissolve, otherwise it will freeze, and when it commences to remelt will expand and crack the crucible. This is a point peculiar to aluminum and is responsible for many mysterious leakages of crucibles, for a strained crucible does not always leak at the time the damage is done, but often runs two or three heats before it goes to pieces. No buttons should be left in the crucible, for with aluminum these buttons cause bottom leakage.

The flux that has given the best results in aluminum is chloride of zinc. The zinc combines with the oxygen which is taken up from the aluminum oxide and forms zinc oxide, which is then skimmed off together with the aluminum chloride that is also formed in the reaction when the flux is added. The best time to add this flux is after the melting is completed; the surface of the molten metal is then covered with a mass of dross, but when the chloride of zinc is dropped on it in small pieces it will become clear as soon as enough of the flux has been added. A piece the size of a walnut is sufficient for a crucible containing 50 lbs. of metal. The metal should be stirred immediately after the addition of the flux is made and then skimmed. Foundrymen who have never given this flux a trial on aluminum, should do so and they would find it gives excellent results on this metal.

A SAFETY DEVICE FOR DROP HAMMERS.

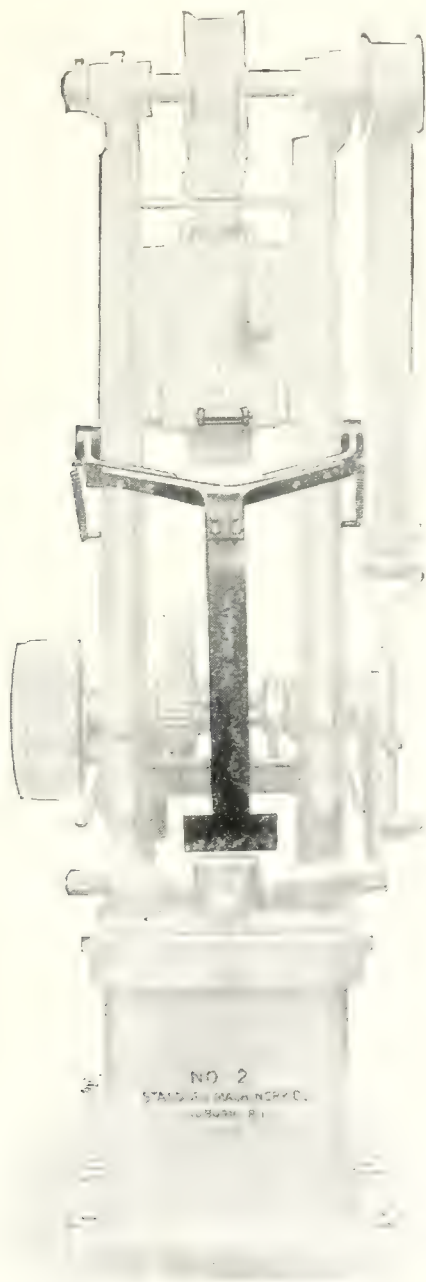
One of the newest developments of the Standard Machinery Co., Auburn, R. I., in the shape of a safety device for use with drop hammers, is illustrated herewith. This is the recent invention of W. T. Murphy, general manager of the company, and is designed for use on any type of plain, automatic or board drop hammer, where the operator has to use his hands to place work on the die.

As will be seen from the cut, a fan or blade of the device swings over the face of the die. When the hammer is at the highest point of its stroke, this fan is at the back of the die, which is then exposed for the operator to place his work thereon. As the hammer descends, the small roller shown above the device, comes in-

to contact with the inclined arm, the blade of which pushes the operator's hand out of danger. As this blade is leather-covered, it cannot injure the hand, in case of a sudden descent of the hammer.

The safety guard comes into operation no matter how the hammer is caused to descend, whether in normal working, or in the event of breaking of some part of the machine.

The springs shown at the sides bring the

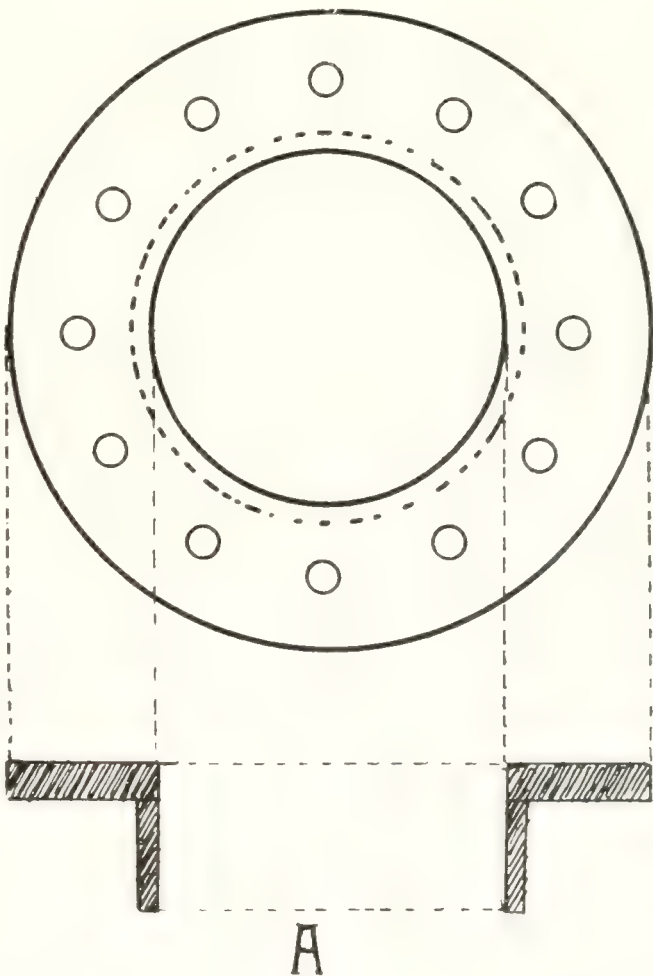


fan back to its original position when the hammer rises.

The simplicity of the device will recommend it to manufacturers solicitous concerning their employees' welfare, and it is claimed by the company that there is no other device in the market which is absolutely certain to operate whenever the hammer descends.

Mixed Metals—Brazing Metal

Brazing metal is the name commonly applied to an alloy that is used by coppersmiths for pipe flanges and other cast parts of wrought copper work that have to be brazed. Any alloy of sufficient strength can be used for this class of work provided its fusion point is sufficiently high to withstand a brazing temperature without melting, and at the same time be sufficiently ductile not to crumble. These qualities are found in the copper-zinc alloys, but in order to withstand brazing the content of zinc is necessarily low. A



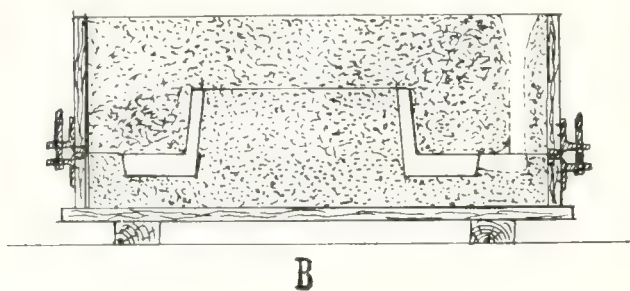
very satisfactory alloy and one extensively used has the following composition:

- Copper 86½ pounds or 8,650 grams
- Zinc 12½ pounds or 1,500 grams
- Lead 1 pound or 100 grams

The lead is added to facilitate machine work, as without it the alloy is very tough and it is more difficult to turn the castings, as pipe flanges are generally faced off and bored out. The castings generally strip from the sand very clean and resemble externally, copper castings. Some of these flanges are quite heavy and are shaped as at "A" in the illustra-

tion, being merely a short sleeve fitted with a comparatively heavy flange which furnishes the medium for bolting the lengths of copper tubing together. The copper pipe is attached by brazing to the sleeve portion of the casting and the latter as well as the pipe are brought to a dull red heat over a suitable forge or by means of gas torches, in order to melt the spelter solder and get it sufficiently fluid to flow into the small aperture between the sleeve and pipe, and sweat them together. It is, therefore, necessary for the alloy to possess a certain amount of ductility at this temperature, and in this respect the mixture given above has been found quite satisfactory.

The easiest way of molding these flange castings is with the flange uppermost, in the position illustrated by the cross section "A," but the easiest way is not always the best, and this is often the case in this particular in-



stance as a molding difficulty is very liable to occur which is the source of a heavy loss of castings. This difficulty takes the form of a deep crack at the junction of the sleeve and flange, but it is in no sense a crack, although it looks very much like one. The defect is caused by the casting pulling apart at the moment of solidification, as at this stage the alloy is weaker than many other alloys, and as the flange cannot move the slightest bit toward the sleeve, being held securely by the broad expanse of sand on which it rests, it follows, that in order to maintain continuity the sleeve would have to move toward the flange. This, on account of its weight it cannot do, and the result is a separation, more or less complete, of the flange and the sleeve, which quite often manifests itself as a crack or shrink, as it is often termed. It is never good policy to mold such castings with the sleeve part "hanging," as although no separation may be observable, hidden cracks may be produced or strains may develop that materially weaken the casting at the point where flange and sleeve connect. A more satisfac-

tory way of molding these castings is shown at "B" in the illustration, which shows them molded flange down. The adoption of this method will entirely eliminate all trouble from cracking, as the weight of the sleeve holds it firmly in contact with the flange, and although it is a little more difficult to mold them this way, this is more than offset by the increased number of good castings obtained. The work of molding can be greatly facilitated by giving the pattern draft along the lines suggested in the illustration, although it is not necessary to give as much draft as shown, as this feature is purposely exaggerated in the illustration for the sake of clearness.

A Well-Equipped Foundry

One of the best equipped foundry plants in the east is that of E. A. Williams & Son, 105-111 Plymouth St., Jersey City, N. J. The specialty of this firm is the well-known "G" bronze for bearings and machine castings.

The total floor space is 11,000 sq. ft., while the daily melting capacity is 16,200 lbs., the average for the last ten years being nearly a million pounds of metal per year.

A good deal of work is done both directly and indirectly for the U. S. government, which is of course subjected to government supervision and inspection. A recent example of the firm's success is shown by the making of 202 heats with only one rejection, under the inspection of the Bureau of Steam Engineering, and of 78 heats without rejection, under the Panama Canal Commission inspection.

At the present time the firm is working on one of the largest orders for bells ever placed by the U. S. government. The order calls for seventy bells ranging from 225 lbs. to 1,000 lbs. The size of this order indicates how well E. A. Williams & Son are equipped for this work. The dimensions of the molding floor are 28 x 100. Besides this there is another molding floor for the molding machine department exclusively.

The firm is equipped to handle multiple work and individual castings weighing up to 2,500 lbs. The newest foundry devices are in constant use, and 75 per cent of the work done is guaranteed as to alloy and mixture. The "G" bronze has an average tensile strength of 38,000 lbs., as compared with U. S. Government bronze 32,000 lbs.

GATES OF BRASS—PART II

By RUSSELL R. CLARKE.

Continued from page 98 of March issue

The advantage of stepping, instead of dropping the metal directly down, exists by virtue of the law of falling bodies and is sometimes under-estimated. Briefly that law is: Velocity—and consequently force—increases with time of descent. At the end of $7/10$ of a second velocity is 7 times that at end of $1/10$; beginning at one, velocity at ends of seconds in numerical order is 32.2, 64.4, 96.6, etc., feet per second. The conceived force of metal as it fairly leaps from the crucible to the gate funnel a few inches away is not the liquid force impinging on the sand surface of the gate button farther down, but merely a fractional part thereof. In the instance illustrated the stream enters the funnel by 4 inch drop at a $4\frac{1}{2}$ -foot-per-second velocity. Should it strike button C by direct drop it would do so with an 18-foot-per-second velocity and an approximate momentum of 60. This constitutes a liquid metal force greater than its sand surface resistance, so we break the force by partitioning the gate. Should conditions conflict and deny us this advantage we would use a strong dry-sand button core at C for its more effective resistance.

In connection with this point of position, the question of leading the delivery direct from the drop gate to the mold in a line level with its base may arise. To this there can be no excessively important objections though reasons opposing are stronger than those supporting it. Chief among these is the fact that the metal is less prepared to enter, and the mold less capable of receiving it safely by this route. Entering thereby, the mold's bottom surface is swept by all the violently intrushing metal required to fill it, in part the core must intercept this force and suffer from it, while every section of bottom surface falls heir to its destructive tendency. A liquid mass rising under restraint compared to a free and rushing current will illustrate the points of difference. When resorting to the direct gate constructive care should be taken to insure that it enters the mold at

an angle sufficiently acute to be out of line with the core and direct the current to a circular motion in the mold.

But we must rise to the riser. Its function is often misconceived. It is not of necessity a skim gate. In the present it subserves this purpose though not as a distinctive object. Attached to highest point of mold-metal occupancy it generally acts as a skim gate, otherwise it often doesn't.

An avenue of escape for developing gases and vapors it can never safely be. These gases and vapors arise in the mold and course through it. Given the freedom of the riser in vacating the mold they escape violently and with sufficient force to impair it. For this reason the top of the riser should be covered and the cover weighted in pouring. That the riser affords additional pressure is another delusion. Otherwise the whole theory of hydro-statics would collapse. By principle the metal is not forced in the riser to its liquid level in the pouring gate, but seeks that level of its own inherent nature as a liquid. The absurdity of the additional pressure idea will readily appear from the following: Suppose the 7-pound pressure of the pressure gate to be doubled in the mold by virtue of the riser. Then we will have a 14 pound per square inch pressure on the top surface of the mold. By law this pressure is equal at all points in the same horizontal plane, hence it would have to be 14 pounds at that point in the pouring gate. We would then have under identical conditions a 7-pound pressure balancing a 14-pound pressure, which is an absurdity. The fact is that a hundred risers would neither add to nor detract from the pressure realized any more than would the excessively large sprue. It all reverts to the same principle, "pressure from height only."

The riser is the mold's medium of relief from a sudden application of force, a sort of shock absorber, a "service" application of brakes. Ever know you could have air-brake service in a mold? Cover your riser airtight, weight the cover down and notice how

the metal fails to rise to the level of its source therein.

The riser then is the mold's realization of the difference between a body stopping suddenly by collision and gradually coming to rest through application of restraining force. Hard-driven by pressure, the rising mass acquires a momentum which would carry it beyond the point where its applied force is withdrawn. Thus metal poured hard will overflow the riser by several inches, while metal in a short-poured casting gated at the bottom will often be found higher than that in the gate. Productive of strain in the mold as the metal strikes its cope surface we have then the driving force and the momentum of the system. To overcome we use the riser, and assign their destruction to the same agent that produced them.* In addition the riser exercises partially the functions of a feed-gate.

The gates thus far considered are those applying to heavy work gated from the bottom. In every mold where depth is sufficient to warrant, this is the natural, logical selection for gate entering locality. Paradoxical as it may appear, it is nevertheless true that metal will drop in a gate and rise in a mold from its bottom to greater casting advantage than by dropping direct from its top to its bottom. Even in thin casting molds partitioned by intricate cores, as they often may be, we find corroborative evidence of the principle's stability. Consider, for instance, a chime whistle body. Position of casting is vertical, the walls and webs are very thin, the mold congested with cores and the rising height of metal 14 inches. Surface reasoning indeed might dictate the conclusion that metal will run this mold with greater fidelity from top than from bottom ingress. Results obtained from actual practice, however, upset this surface-derived conclusion and point to more stable principles deeper down. We might remark here that these considerations plainly indicate the folly of elevating the pouring ends of molds gated for horizontal casting position. In heavy work this practice results in unequal distribution of pressure; in light, it gives the metal opportunity to separate and chill before affecting a complete reunion. In short, horizontal molds yield best results when poured strictly on the level, except in long thin castings, when slight elevation of the end opposite the pouring gate

will, if properly poured, afford improvement.

Briefly the advantage of bottom gating is derived mainly from the following readily observed facts:

1. It makes the drop gate a skim gate.
2. It prevents disassociation and preserves compact metal mass in filling the mold.
3. It graduates core gas formation and permits its natural escape upwards.
4. It drives all gas and vapor pressure ahead of the metal and prevents their confinement in pouring.
5. It "positions" the delivery gate at a point where two pressures oppose each other with maximum strength, forcing a compact metal union and eliminating pin holes and shrinkage in this vicinity.
6. It limits all force of falling metal and consequent commotion to gate locality where greater freedom in constructive manipulation is licensed.
7. It facilitates while in its more liquid state the escape of gases absorbed by the metal in melting.
8. It practically insures surface position of all dirt, dross and oxide developed in the mold.
9. It delivers the metal to the mold under sanction of contraction's law, the last metal entering bearing a logical relation in temperature and mold vicinity to that first poured.

As already indicated, the skim gate is an avenue of escape for developing dross. Its point of position must be reckoned from the influence exercised by the delivery gate and the contour of the pattern on the motion of the liquid mass in the mold. Usually, though not always, this point lies opposite the pouring gate. Generally it should lead from highest point of metal occupancy, though this also is subject to modifying influences.

The pop gate idea applied to skim gate function in brass and bronze is illogical. The unequal degree of contraction superinduced by variation in mass of metal in gate and casting respectively often results in a cavity directly under the gate in the casting. The better plan is to follow out the connecting gate idea. In so doing the connecting gate should be cut sufficiently broad to encompass considerable mold space and amply deep to insure freedom from clogging. When the pop gate feature is observed the gate should be made broad and thin at vicinity of union with the casting.

A feed gate is an additional pouring gate attached to some particular vicinity in the mold, this vicinity requiring the presence of metal higher in temperature than that fur-

*Gravity.

nished it by the original pouring gate. Its advantage arises because of the cooling of metal in running and variation of its mass in a casting. At the instant that the metal from the original pouring gate enters the bottom of the feed gate the higher temperature metal should be poured into the feed gate. A horn gate is a gate resembling a horn. It can be easily made by casting first from lead, bending to the desired shape and recasting from this as a pattern, of some more substantial material. The horn gate represents a variation in gate construction objective to reaching some advantageous position of gate application inaccessible to the horizontal delivery gate. In attaining this end the metal is made to course under the mold and up to the position desired. The principle is a good one, though the gate is subject to the impairing tendency of illogical mechanical construction. A delivery gate, it merits all the critical consideration native thereto. Excess of taper to facilitate drawing results in waste of metal and violation of good gate principle. Leading under the mold the radius of curve should be amply extensive to permit a good body of sand between its own and pattern impression. Through the medium of covering cores the principle can be duplicated in various ways. The gate in our illustrative mold is an example.

The drop-pouring gate is a method of introducing metal into a mold with maximum speed and cleanliness. It consists in enlarging the cavity of the funnel top sufficiently to hold all the metal required to fill the mold and its gates. Forming the bottom of the cavity is a bowl or cone-shaped dry sand core with a cone-shaped hole in the bottom, into which a stopper core is neatly fitted much the same as a glass stopper fits a bottle. In pouring, the cavity is filled with metal and the stopper core suddenly withdrawn, permitting the metal to escape downward en masse and into the mold. Very often the cavity or reservoir is constructed entirely of dry sand. The advantage to be derived from the use of this gate applies principally to very light and thin castings where quick work in pouring is necessary, and in extraordinarily particular work demanding high standard of purity in metal. Additional insurance in the latter instance results from covering the surface of the metal with pulverized charcoal just prior to lifting the stopper core.

Of all gates leading to a mold, the delivery is the most constructively important.

There's where we get the last crack at law, the last law opposing casting solidity, the law of contraction. Expansion and contraction are general effects respectively of applied heat and its absence. They vary in extent with degree of prominence in the affecting agents and the mass of the substance affected. They constitute forces as uncompromising and nearly irresistible as any of which we at present have knowledge. However, their effect in a mold can be dominated. The principle that contraction in two bodies of the same substance unequal in mass and unequally heated can be made to observe equality in extent when these bodies cool to the same temperature makes possible the construction of a gate exercising partial control over the unequal contraction superinduced by variation in mass of its own metal and that of the casting. Nor are gates of great volume necessary to this end. A heavy gate may sometimes be a good thing, but a logical gate is always a better one. It is also cheaper.

A logical gate is a gate cut in the right way at the right place in a mold. Briefly then we have to consider: First, Gate Construction, and second, Gate Placement.

I. *Gate Construction*.—The whole philosophy of logical shape and volume in a gate consists in establishing co-operation or opposition of one law or feature of law with or to another, co-operation applying to forces of good, opposition to those of evil consequences. Of the two, the latter are the greater, hence their demand for greater consideration which leads to the conclusion that we must war on evils by inciting their producing forces to rebel against each other and nullify effects by neutralizing causes.

The primary evil of contraction attending liquid to solid reduction is a draw or shrinkage cavity that will locate somewhere either in the gate or casting. To confine it to the former and keep it out of the latter is our gating task. Fundamental in importance thereto is slight and gradual reduction in gate volume from source to mouth and application of ample pressure. In this variation of gate volume it is quite essential that the volume of all preceding gates be reckoned from the volume of the gate necessary at point of casting union to meet its existing local conditions. Thus to the delivery gate is attached the importance of determination. We must understand also that the casting evil of contraction in brass is greatest at or near the freezing point of the metal; that after solidity

has once been attained the effect of contraction is seldom if ever localized. To elucidate our understanding, and with these facts in mind, let us consider gate construction in connection with figures 3 and 4, illustrating judicious gate construction as applied to light and medium work respectively. Taking figure 4 as representative, let us note the action of metal and the effect of principle. Suppose a-b-c-d-e to represent metal at different localities in the mold, as indicated, then at the exact instance of pouring completion, e is slightly hotter than d, d than c, c than b and b than a, metal a entering the mold prior to b, b to c, etc.

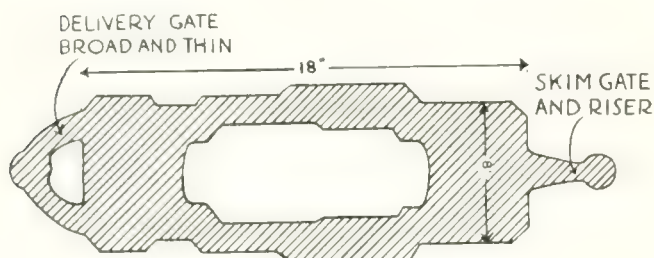


Figure 3

Now by virtue of this lower temperature and greater radiating surface, a develops an outer solid crust in advance of b, b of c, etc. Consequently a starts to shrink; b-c-d-e, being partially liquid, transmit gate pressure and supply of metal to overcome. Likewise with b and c, c and d and d and e. Shortly these all develop a solid outer crust which slowly moves inward toward the centre of the casting. Now by virtue of excess mass and in spite of difference in temperature centre of casting in AR section if left alone would be the last to solidify, hence there is attempt at a constantly developing vacancy narrowing centeward in A R until A R is solid from centre to circumference. This developing cavity affords a diminishing reservoir into which the central stream slowly transcouring* e-d-c-b in lieu of gate pressure and attraction of molecules empties. Finally A R stages complete solidity and the limit of the central stream creeps slowly back to b, to c, to d and the casting is solid, e then is centrally plastic, the metal behind it sluggish, but the metal in the pressure gate is still centrally liquid and driving away to forge this plastic mass into the last semblance of an unnatural pore or cavity ahead of it.

And this is the law of solidity; that this liquid mass cooled from circumference to

centre and transmitted its own pressure undiminished in all directions forcing its own successively congealing particles to compact union with the frozen particles above, beneath and beyond it until the last congealing particle slowly yielded to solidity while faithfully endeavoring to force itself still further into the solid mass ahead of it. And this is the principle of construction: That we so shape the gate at its point of union with the casting as to realize maximum volume in minimum space, and prevent complete solidity in the gate in advance of complete solidity in the casting, that we enlarge on this volume in the gates preceding for the same purpose and heighten the top of the pouring gate sufficiently to afford a pressure that will drive a liquid mass onward in its every stage to solidity and what happens? Do we eliminate contraction? No, contraction cannot be eliminated, we simply control it, confine it to the gate, in localized effect; and that is where you will find it, find it visibly manifested somewhere—very often in a central cavity in the pouring gate extending halfway downward from its top to its bottom. In our delineation of these features the notion may arise that we have overestimated the value in effect of little things; our reply is that nature always makes the most of everything. To verify the logic

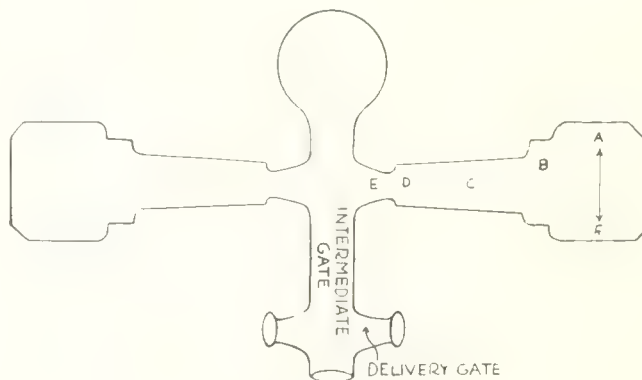


Figure 4

of the contention reverse the order of things, cast one mold from each order observed, compare the casting and draw conclusions.

In vicinity D of the casting we frequently run up against the pin-hole evil, an evil that came in with the trade and bids fair to go out only when the trade shall have ceased to exist. Pin holes are in most cases consequences of one or several of the following: hard ramming, wet sand, improper gate construction, double gating, cold metal, lack of

*This suggests relation in idea to the well known fact that running water is slow to freeze.

pressure, and improper gate placement. Briefly these in order mean simply: Reaction of heat action metal-ward; presence of excess vapor pressure, violation of principle; unequal degree of contraction; physical inability to obey law; preponderance of force super-inducing evil and variation of effect following variation of conditions and demands. We shall comment only on the first. In gate tamping considerable freedom is allowed and hard tamping is unnecessary. However, this freedom should not be abused. Liquid in common with all other pressure will seek lines of least resistance and a swollen gate indicates a detracting of pressure from the casting. Again the happy medium has the call. Figure 6 represents a very light and thin casting. In gate construction applying to this class of work care should be taken to keep the delivery gate as small as running conditions will allow and all other gates accordingly reduced, the idea being to drive the metal straight through the gates and into the mold, denying it the opportunity to tarry and chill in filling up gates of unwarranted volume. A good pressure gate is essential to this driving force, the riser gate to the relief of the mold.

II. *Gate Placement.*—The first law is: Gate at the lowest possible advantageous point of the mold. Other than this no binding general rule can be prescribed. The common notion that the heaviest vicinity indicates gate vicinity is in error. Figure 7 violates both spirit and letter of this conception and yet we know the gating in figure 7 to be correct and logical. Out of 100 castings gated at the small end none were defective; out of 50 gated at the large end five showed large pin holes and developed spacious cavities farther back in the heavy part of the casting when machined.

Yet from a single instance it cannot be taken as a fixed rule that the heaviest part should never be accorded gating position. This feature of the case must be disposed with according to the law and the evidence at hand. Every class of work, every differing pattern has its own peculiarities and variations. These are the decisive arguments in determination of gate placement. Very often the problem is perplexing. Not infrequently conditions conflict and forces conspire against them when co-operation with each other is sadly needed. However, law and principle are inviolate and infallible. We can depend on them always, they never fail. To study and

apply knowledge of their nature and effect, to reason critically, conclude logically and execute carefully is a pleasant task and will seldom fail in revelation of a natural and efficient order of escape. When the molder has developed a high class ability of fore-thought he can well afford to let after-thought and consequences take care of themselves.

Diversity in qualities denies us any general law governing expansion and contraction in different elements either in solid or liquid state. Metal alloys being unions of metal elements it is at once obvious that differing alloys differ in contractive tendency and that gate construction applying to differing instances must be varied accordingly. Evading for sake of brevity an extended consideration on this phase of the subject we shall merely state that copper and aluminum exhibit most pronounced shrinking and drawing tendencies, that in combination they retain this quality, that in the copper-tin and copper-tin-lead alloy this tendency reduces considerably while with the addition of zinc it again becomes more prominent. Thus larger and more critically constructed gates are essential to solid brass than those necessary to compact bronze, all things else being equal.

By way of conclusion we shall supplement with several "Don'ts" derived from actual foundry experience in the different capacities of molder, inspector, and instructor.

1. Don't position a gate without a reason. Study the pattern and derive one.

2. Don't choose drop gates at random. Select them carefully; make them fit the occasion.

3. Don't use sand around a gate you would not use around a pattern. Both are exposed to the same liquid metal; the gate, for a longer time.

4. Don't cut a gate not knowing the nature of the metal it is meant to convey.

5. Don't make metal transcourse greater gate distance than necessary.

6. Don't cut rough and sloppy gates nor broad thin gates for heavy or medium castings.

7. Don't try to cut a neat gate with a dull tool; it can't be done.

8. Don't force a form into the sand to make a button.

9. Don't get the button out of line with the drop gate or make it less in diameter than the drop gate at its lower end.

10. Don't neglect the fillet at casting union. It may prevent a draw.

11. Don't use water in gates. Finger them smooth though not to excessive hardness.

12. Don't cut double gates of unequal length or volume. The one may draw from the other.

13. Don't gate from one casting to another.

14. Don't use double gates on ring-shaped castings. The two streams meet at a point opposite the drop gate, deposit their dross at one place and sometimes fail to unite properly.

15. Don't gate at right angles to a green or dry sand core in the mold.

16. Don't direct a rushing stream of metal at or over soft green sand projections in a mold.

17. Don't gate in the middle of long and uniformly thick castings. Better at the end.

18. Don't gate on the teeth of gear wheels. Use a horn gate or duplicate it.

19. Don't gate thin discs or wheels with heavy centers on the light rim surface.

20. Don't position gates too close to the edge of the flask.

21. Don't permit a leak between the successive sections of a pressure gate; the casting suffers the loss of pressure attending the leak.

22. Don't expect scrap metal to hold up under the same pressure as will new metal.

23. Don't trust to luck or take chances. Principles never recognize them.

24. Don't squeal about "bum" metal every time a casting shrinks or draws. First look into your molding and gating practice and conditions.

25. Don't expect these "don'ts" to cover every case.

QUESTIONS AND ANSWERS

All communications under this head should be addressed to the "Questions and Answers Editor"

Titanium Aluminum Bronze

In my work I have found some metal which goes by the name of titanium aluminum bronze, and as I have no way of telling the exact percentages without an analysis, I am writing to you to find out if you can tell me a method. I am analyzing it and have gotten all the metals out but the titanium and do not know how to proceed for it.

ANSWER.—First make qualitative test for presence of titanium (we doubt whether it will be found). If found, proceed as follows: Weigh out one gram of sample, dissolve in H_2SO_4 1-3, dilute somewhat with water and add cautiously stick sodium hydrate until all aluminum has redissolved. The iron and titanium will then be precipitated. Filter, redissolve, precipitate and again precipitate iron and titanium as before. These operations, if properly done, should give a precipitate free from aluminum. Now burn and weigh combined oxides of iron and titanium. From this estimate iron in usual way by titrating with permanganate. From this amount of iron calculate to oxide, subtract from combined oxides, and difference is titanium.

Copper Plating on Steel

We have some cold rolled steel strips to copper plate and wish to use the acid copper plate, because we think we can get a little heavier coating of copper than with the cyanide copper strike. Is it practical as well as possible to plate the acid copper to the steel direct? That is, without first plating the steel with the cyanide copper strike or a nickel plate.

ANSWER.—Give a coating in copper cyanide solution, and then in order to obtain the necessary thickness deposit copper from an acid copper solution. The solution cannot be used for plate directly because it won't adhere. Acid copper solution is made as follows: Water, 1 gal.; copper sulphate, $1\frac{3}{4}$ lbs.; sulphuric acid, 1 oz. Use from 1 to 2 volts.

Oxidizing Brass

Can you tell us how we can oxidize brass? We have no difficulty in doing this with copper, but we have tried the various methods given for brass, but without results.

ANSWER.—Oxidize by using ammonia and carbonate of copper as dip, or by means of a black nickel deposit.

Nickel Salts

Please advise how many pounds of double nickel salts to use for a vat that holds 250 gal. of solution, or how many ounces to the gallon?

ANSWER.—The best formula for nickel plating is as follows:

Water	1 gal.
Double nickel salt.....	8 oz.
Single salt	1 oz.
Sal ammoniac	1 oz.
Boracic acid	6 oz.

Have water hot in making up, but use solution cold. Follow this and you will have no trouble.

Magnesium on Aluminum

What effect has the addition of magnesium on aluminum? We understand that alloys of these two metals are being used extensively for aviation purposes because of their strength and lightness. About what percentage of magnesium produces the best alloy with aluminum? Would we be likely to encounter any more difficulty in casting such an alloy than in the case of the number 12.

ANSWER.—Magnesium has a hardening effect on aluminum. Magnalium is an alloy of aluminum and magnesium in the proportions of from 7 to 8 per cent magnesium, and 92 to 93 per cent aluminum. The resulting alloy possesses considerable strength and ductility, but is very difficult to cast in sand molds as it decomposes water with great ease when hot. We fear that much trouble would be experienced before the difficulties encountered would be overcome and an encouraging percentage of good castings obtained. We doubt whether any considerable percentage of magnesium-aluminum alloy castings are being made at the present time on account of the high cost and the difficulty of obtaining magnesium. This metal is not being made at present in this country and the imports from abroad have practically stopped. The war has created a big demand for magnesium, not for aviation purposes, but for use in the powdered form as magnesium flares or bombs, to illumine the country in the neighborhood of the trenches. A company has been formed for

the manufacture of the metal in the United States, the plant to be located at Niagara Falls, but it is not as yet in operation. We would suggest that you continue with the number twelve alloy and not try any changes at present.

A Finish for Steel

About a month ago I wrote you for a blue and black finish on polished steel. In your reply you gave me the saltpeter heating process. This is something I cannot use, as the part of the goods which is to be blued is tempered steel and the 600 F. will soften the steel.

ANSWER.—A good blue is difficult to obtain. Try the following: Dip article in a 1/2 per cent. solution of red prussiate of potash, mixed with equal volume of a 1/2 per cent. ferric chloride solution.

Metal Polish

Will you kindly furnish us with a good recipe for making a liquid metal polish for cleaning brass. We have several recipes for this purpose, but they are not very satisfactory.

ANSWER.—The best metal polishes are made by mixing together very fine Tripoli powder, ammonia and gasoline. The proportions are best worked out by you to suit your conditions.

Black Antique Silver Finish

I have a quantity of small tin articles on which I wish to get a black antique silver by simple immersion (without current).

ANSWER.—It will be necessary to silver plate the tin articles first. There are several ways by which the antique finish can be obtained.

1st—Coat them with thin paste of 6 parts graphite, 1 part red ochre and enough spirits of turpentine. After drying, rubbing with soft brush, the reliefs are set off by means of a rag dipped in alcohol.

2nd—Brush the silvered articles with a soft brush moistened with dilute alcoholic solution of chloride of platinum.

3rd—After being silvered, immerse the articles in a solution compound of 2.75 drachms of liver of sulphur, 5.50 drachms Ammonium Carbonate, 1 quart water @ 176° Fahr. Allow articles to remain until desired tone is obtained.

Sand for Molding

By CHARLES VICKERS

Molding sand is practically a mixture of silica and clay with varying proportions of iron oxides, lime, magnesia, organic matter and water, the most essential qualities being refractoriness, porosity and plasticity. The first mentioned requisite is determined largely by the amount of silica contained in the sand. This may vary from 70 to 90 per cent. The size and shape of the grains of silica, and the quality of the clay bond also effect the heat resisting qualities of the sand, which while very important are not more so than its porosity, which while a factor of the percentage of silica also depends upon the size and shape of the grains. Without plasticity the sand, of course, would not conform to the shape of the pattern, or maintain its shape before the molten metal. The less iron, lime and magnesia the sand contains the better, because these substances combine with the silica to form more or less fusible slags called silicates. The most troublesome impurities from a brass molding point of view are soda and potash, as these form silicates that fuse at a very low temperature. Silicate of soda melts at around 1500 degrees Fahr., which is considerably below the pouring temperature of most copper alloys, consequently a sand containing much alkali would fuse onto the surface of the castings, and in addition to being difficult to remove would give off gases that would leave holes in the castings. The higher the melting point of the metal to be cast, the more refractory the sand should be from which the molds are made. Thus a very refractory sand is required for nickel, which melts at a temperature of 1450 degrees Cent. (2642 Fahr.); also for steel which fuses at about the same heat. Very few natural sands will withstand a temperature of 1400 Cent. and not fuse, therefore in casting steel the molds are invariably faced with a very refractory facing of pure silica bonded with fire clay, as ordinary molding sand would produce a pitted surface on the castings. As brass and bronze melt at a much lower temperature than nickel, refractory facings on the molds can usually be dispensed with, as the sand in its natural state is not fused by the heat of the bronze unless the latter is in heavy masses, in which case it is advisable to employ such facings, and to supplement them by a thin film of some such heat resisting material as graphite.

In addition to such qualities as refractoriness, porosity and plasticity, grain size is also important in molding sands. As a general rule the finer the sand the more impervious it will be to the gas generated by the heat of the metal, and if this gas cannot pass freely away it will cause such difficulties as scabs and blowholes, consequently a fine sand should not be used to form molds for heavy castings, because the larger the body of molten metal the more gas that is generated thereby, and if it cannot pass away defective castings are sure to result. There is also a difference in fine sands, some can be used with impunity for casting comparatively large masses of metal; others scab and blow with the greatest ease. The difference may be due to the shape of the individual grains of sand because if the grains are angular and of equal size, the pore space will be increased as angular grains do not pack as well as the more rounded grains, consequently the gas permeates the mold better and is pushed out by the advancing metal. In addition to the grain shape, some fine sands contain too high a percentage of clay or alumina, and as a consequence the sand packs so solidly that it has no permeability and the gases cannot escape.

Such sands will not "take water" after they have been used for casting; when the sand is sprinkled after the molds have been cast and shaken out, the water will run off instead of sinking into the sand, such sands are unfit for other than very light work, and even then will prove a source of much difficulty.

A simple test for sand that is often advocated is to fill a fruit jar one-third full of the sand under observation, then fill up with water and shake the contents thoroughly to mix the sand and water. The jar and contents are then allowed to stand for an hour or so until the sand has settled, when the silica will settle first because of its greater specific gravity, while the clay or loam is held in suspension much longer, so that when all the sand has settled and the water is clear, the greater part of the silica will be at the bottom of the jar and a line of demarkation will show the relative proportions of silica and clay in the sand. The more silica the better the sand for molding purposes, provided it has the necessary bond or strength. It follows, therefore, that of two sands, the one from which the largest amount of silica settles, will be the best selection as a general rule, because if it lacks strength or bond, that fact will be evident to the "feel" as this is a test a foundryman al-

ways instinctively applies to a new sand.

As before mentioned the percentage of silica in a sand may range from 70 to 90, but this amount will not show in the water test, because a portion of the silica is combined with the alumina and because of this it will often appear that the silica is much lower than the percentages stated. In general, if the silica as shown by the water test appears less than 25 per cent of the bulk of the original sand, the latter is very dubious, and it might be well to make another selection.

Whenever a molding sand scabs and blows very easily, requiring an excessive use of the vent wire to obtain decent castings, something is radically wrong and an investigation should be instituted to discover the cause of the difficulty. There are few molding sands that cannot be improved by an addition of silica, added in the form of what is known as glass sand, even stove plate castings have been made successfully in silica sand artificially bonded by the addition of clay. Indeed, such castings run better in such sand than in a natural molding sand, because the gases can pass away with great freedom, and do not hamper the movement of the metal. There is a considerable difference in the size of the grains of a silica sand, and it is obvious that a very coarse sand, such as is used for sand blasting purposes, even when mixed with the proper portion of alumina, would make very rough castings. When silica sand is used for molding purposes it should be very fine, and such sand mixed with about 10 per cent pure clay has been extensively used for molds with excellent results, the idea being that an artificial sand, being free from such objectionable impurities as lime, iron, organic matter and alkalis, would give better results as a molding medium.

When a molding sand is considered too close, that is, when the gases cannot freely escape and defective castings result with too great frequency, and it is desired to mix silica sand therewith, the proportion to use is about 60 per cent silica sand and 40 per cent fine sand, and this mixture can usually be relied upon to produce good results. As before mentioned the silica sand should be of the requisite degree of fineness; the amount of regular molding sand to mix therewith while around the proportions stated will depend a great deal upon the nature of the sand, so that judgment must be used not to weaken the bond by the addition of too much silica, so that the mixture is molded with difficulty,

otherwise the cost of the castings will be increased unduly.

Core Compound

A homemade core compound for bonding cores for brass and bronze castings that is held in high regard in some foundries is made as follows: A watertight barrel capable of holding 50 gallons is provided and filled half full of clean water into which is stirred one ordinary pail full of glucose. Three pounds of flour are then mixed to a batter with water until about as thick as cream, and this mixture is also added to the barrel containing the mixed glucose and water, the whole being thoroughly stirred and the barrel filled with water, making in all 50 gallons of solution. This mixture is then used to wet down the sand from which the cores are made. The sand itself consists of 50 per cent of burnt sand from the castings, 25 per cent of floor sweepings and 25 per cent of new sharp sand, the whole being passed through a fine sieve to remove lumps and then wetted with the core compound from the barrel. This mixture of core sand it is claimed makes cores that will not sag, or blow and leave a clean hole in the castings.

A Novel Method of Obtaining Gold Filings.

The Gustave Fox Co., of Cincinnati, writes us as follows:

"We have often heard about manufacturing jewelers moving and taking up their old floor to obtain all gold filings, etc. We have recently moved to 411-413 Race St., from our location on Fourth St., where we were located for about 15 years. The floor was perfect, so instead of taking it up, we used a suction sweeper, hammering the floor alongside of the cracks, and this sweeper sucked up all of the dirt in the cracks.

"We kept these sweepings separate from our regular floor sweepings, and have just finished refining same, and find they netted us about \$1,200.00.

"We thought this item might be interesting to your readers, in that we have often heard about people successfully removing their floor, and securing quite large sums from refining the dirt under the floor. Now that we have actually experimented, we recommend our system of using the suction sweeper just as advantageously without the expense of being obliged to lay an entire new floor."

A SHORT OUTLINE OF THE PRINCIPLES OF CHEMISTRY FOR ELECTROPLATERS—IX

By ALLAN J. FIELD.

(Copyrighted by the author)

The Fourth Group.

The following three metals are taken together to form the fourth group:—Nickel, zinc and manganese. They are distinguished from the first and second groups as they are not precipitated by hydrogen sulphide in an acid solution. The three metals have a common property of being precipitated in an alkaline solutions with ammonium sulphide.

Nickel.

Use a dilute solution of nickel sulphate for the following tests:

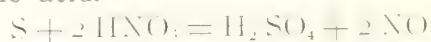
(1) To 5 c.c. of the solution add a few drops of a very dilute solution of ammonium hydrate, (5 c.c. conc. ammonia diluted to 50 c.c. with water) which precipitates a green basic precipitate; it is readily soluble in excess of ammonia forming a complex nickel ammonium salt.

(2) To another portion make slightly alkaline with ammonia, or until the nickel precipitate is dissolved, add 5 c.c. of a 1 per cent solution of ammonium chloride, (which prevents nickel sulphide from dissolving in ammonium sulphide), the solution is heated, then add colorless ammonium sulphide by drops until all the nickel is precipitated as black nickel sulphide (NiS)



The ammonium sulphide solution is prepared by saturating 30 c.c. of ammonium hydrate with hydrogen sulphide, then adding 20 c.c. of ammonium hydrate and diluting with 50 c.c. of water. On standing for some time it will turn yellow; a fresh solution should then be prepared. Nickel sulphide is very nearly insoluble in cold 4 per cent hydrochloric acid (1 c.c. conc. HCl to 9 c.c. water). It is readily soluble in concentrated nitric acid. When the nickel sulphide is heated with concentrated nitric acid sulphur is liberated which sometimes incloses some of the nickel sulphide and prevents the acid from dissolving the sulphide. In such a case small black specks remain which appear to be insol-

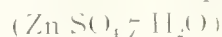
uble, but on prolonged heating they will finally dissolve. The sulphur is oxidized to sulphuric acid.



(3) To another portion add sodium hydrate solution, which precipitates green gelatinous nickel hydroxide $\text{Ni}(\text{OH})_2$ insoluble in excess, soluble in acids and ammonia.

Zinc.

The following experiments can be tried on a dilute solution of zinc sulphate:



(1) To a small portion add dilute ammonia by drops, a white precipitate of zinc hydrate [$\text{Zn}(\text{OH})_2$] will be precipitated. On adding an excess of ammonia, the zinc hydrate will be dissolved forming a complex ammonia salt. The zinc hydroxide is dissolved by the ammonia more readily at the ordinary temperature than when it is heated. If just enough ammonia is added to dissolve the zinc hydroxide and the solution is heated the zinc is precipitated out as hydrate.

(2) To another portion add sodium hydrate solution; the precipitate is zinc hydrate which is soluble in excess of sodium hydrate forming a zincate, a similar reaction to that of aluminium hydroxide. Unless there is a decided excess of sodium hydrate there will be a precipitation of zinc hydrate when the solution is boiled. This reaction is brought about by means of water and is termed hydrolysis. The reaction can go either way depending on the conditions and for this reason it is sometimes called a reversible reaction. In writing the equation two arrows are used, pointing in opposite directions, in place of the equality sign.



The reaction in the cold goes from left to right; when the solution is heated the reaction proceeds from right to left.

(3) To 5 c.c. of the solution add 10 c.c. of 10 per cent ammonium chloride solution and heat to the boiling point, then add ammonium sulphide until completely precipitated.

The zinc is precipitated as white zinc sulphide (ZnS)



Zinc sulphide will settle out better and will filter quicker if it is precipitated from a boiling solution in the presence of considerable ammonium salts. This rule can be applied to almost all the metallic sulphides. Zinc sulphide is soluble in cold dilute hydrochloric acid (which distinguishes it from nickel).

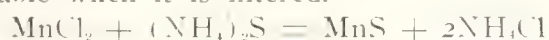
Manganese.

Prepare a 1 per cent solution of manganese chloride for the following tests:

(1) To 5 c.c. add ammonium hydrate; a white precipitate of manganese hydrate $\text{Mn}(\text{OH})_2$ is produced; on exposure to the air it rapidly oxidizes, becoming brown. In the presence of sufficient ammonium chloride no precipitate will form, but on exposure to air the manganese is finally precipitated out as manganese acid $\text{MnO}(\text{OH})_2$ which absorbs more oxygen from the air, forming manganese oxide (Mn_2O_3). The separation of manganese from the Third Group (iron and aluminum) is not complete as the iron and aluminum are apt to carry down some manganese.

(2) To another portion add sodium hydrate which throws down manganese hydrate insoluble in excess of the reagent (distinguishing it from zinc which is soluble).

(3) Another portion of 5 c.c. is heated to the boiling point, then add all at once, 5 c.c. of hot ammonium sulphide. A green precipitate of manganese sulphide should be formed, if it is not formed more ammonium sulphide is necessary. If the ammonium sulphide is added gradually in a cold solution a flesh colored manganese sulphide is precipitated in a very finely divided state. It is hard to filter and does not settle rapidly. The green sulphide is more granular and does not give trouble when it is filtered.



Manganese sulphide on exposure to the air becomes brown due to oxidation to Mn_2O_3 . The sulphide is readily soluble in cold dilute hydrochloric acid (a distinction from nickel sulphide).

(To be continued.)

Cadmium in Brass

Cadmium is added with difficulty directly to molten copper, as it volatilizes and explodes, projecting the copper out of the furnace

to the danger of the operator, even when added in small pieces not larger than a pea. It would be very dangerous to throw an entire stick of cadmium into a pot of molten copper, because if a little piece makes such a commotion, a large piece might produce disastrous results as the experimenter might be severely burned, particularly if he did not know what was likely to occur.

There is no particular reason why cadmium should be added to copper, however, as it possesses no value as a deoxidizer of that metal; in fact, it is not as good as zinc, as one per cent of cadmium failed to produce sound copper castings. When the cadmium was added to the copper the latter metal was bright and clean under its covering of charcoal and the cadmium was added in small pieces, as mentioned above; as previous experience had shown the wisdom of caution, and after the one per cent. of cadmium had been added the copper emitted dense reddish brown fumes of cadmium oxide, just the same as if zinc had been added, only the fumes were reddish brown instead of white. The copper had been very carefully melted, and in such circumstances the addition of one per cent of zinc would have ensured sound castings, but the cadmium treated copper bulged at the heads and was characterized by a condition of extreme porosity. This was rather surprising in view of the fact that cadmium is used as a deoxidizer of sterling silver in the proportion of from 0.5 to 1.00 per cent. Cadmium, however, as it is well known, has a considerable affinity for silver and alloys therewith in all proportions. Cadmium combines with explosive violence also with aluminum, and such alloys should be made with caution.

Alloys of cadmium with either lead or tin are very easily made, and the resulting alloy forms a convenient means of adding this element to copper alloys. The hypothesis had been formed that the addition of cadmium to a mixture of lead and copper would result in the retention of the lead by the copper after the mixture had solidified, that in short, cadmium would "hold" the lead in suspension in copper and prevent it "dropping" as the mixture solidified. Accordingly an alloy of lead and cadmium containing 10 per cent cadmium was first made, and this was added in the proportion of 5 per cent. to a 50 per cent copper, 50, lead alloy, while molten. The percentage of lead added with the cadmium was deducted from the total amount of lead

added to the copper so that the mixture did not contain more than the 50 per cent of lead desired in the alloy. The amount of cadmium added was therefore, 0.5 per cent. The alloy was a failure, the castings were full of holes, and the lead segregated badly. While fluid, the metal bubbled strongly, emitting dense fumes of cadmium and lead of a yellowish brown color. When the molds were poured, the sprue heads continued to give off these fumes until they solidified. The hypothesis, therefore, fell to the ground as it was proved that cadmium possessed no value in retaining lead in alloy with copper.

The lead containing 10 per cent cadmium, is a hard, rather tough white metal which drosses badly.

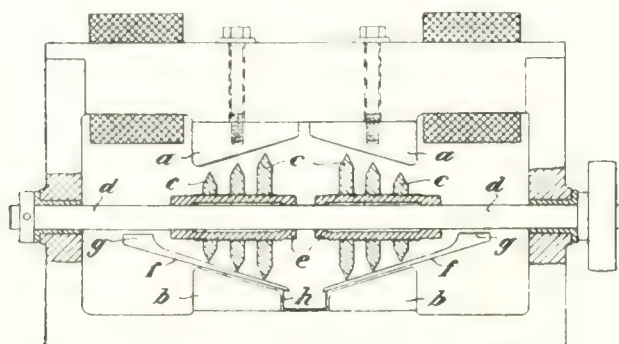
To try the effect of cadmium in aluminum bronze, an alloy of tin and cadmium was made containing 25 per cent of cadmium. This alloy is rather hard and white, but of no particular value by itself. It was used to alloy 0.5 per cent of cadmium with a 10 per cent aluminum bronze. There was no particular difficulty experienced in making the alloy, but no perceptible advantage accrued from the addition of the cadmium. In another trial metallic cadmium was added to a 10 per cent aluminum bronze, in the proportion of 0.5 per cent. The cadmium combined with explosive violence with the bronze, and the alloy emitted the characteristic brown fumes, but no advantage could be perceived, the result being to confirm the previous test, in fact the castings appeared more drossy than usual, instead of cleaner.

In conclusion it may be safely predicted that the demand for cadmium for brass foundry purposes will never amount to very much more than at present.

Patent Review

Patent No. 1,120,822—*Magnetic Separator*.
G. Ullrich, Magdeburg, Germany. Renewed
Feb. 23, 1915. Serial No. 3,631.

This invention relates to magnetic separators

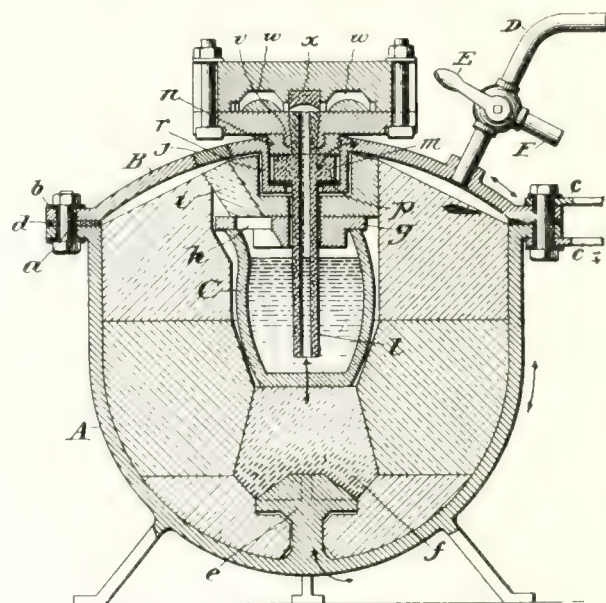


and has particular reference to separators of the kind in which the material to be treated is made to travel in a longitudinal direction between the surface of a magnet pole and a horizontally rotatable cylinder serving as armature thereto, the said cylinder being composed of annular or disk-shaped bodies which are axially adjustable upon the cylinder shaft and are preferably tapered at their peripheries.

The chief object of this invention is to provide a magnetic separator of the horizontal rotating cylinder type in which the adjustment of the magnetic field strength at different parts can be readily effected without involving any changing of parts of the separator.

Patent No. 1,126,079—*Casting Metals of High Melting Point*.

A. L. J. Queneau, Philadelphia, Pa. Filed Jan. 26, 1915. Serial No. 874,092.



This invention relates to the electrical casting of metals and more particularly to an electrical casting furnace adapted to produce finished castings from metals which melt at high temperatures such as brass, phosphor bronze, manganese steel and the like.

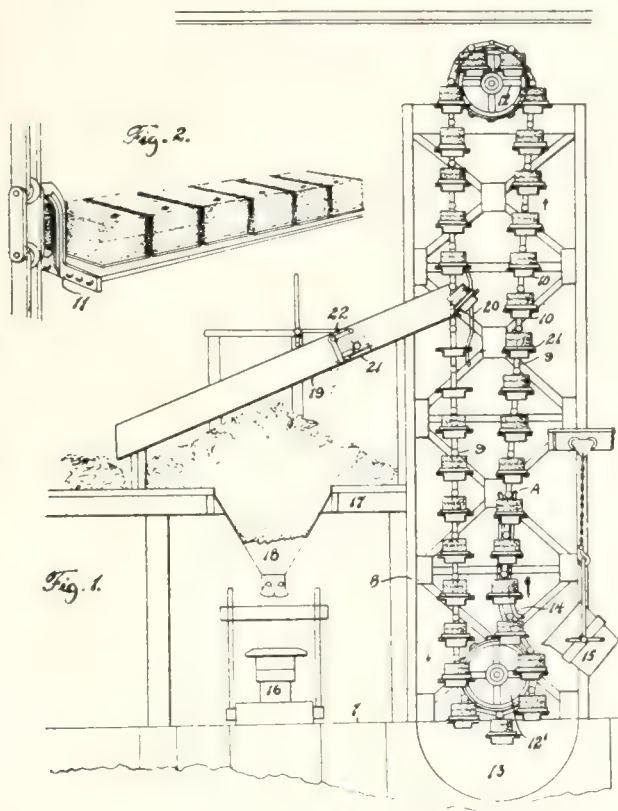
Patent No. 1,123,914—*Method of Making Castings*.

Edgar H. Mumford, Plainfield, N. J. Filed January 5, 1915. Serial No. 815,441.

This invention relates to a method of making castings and it has for one of its primary objects the provision of an improved method whereby the molds are handled in a simple, expeditious, and economical manner and whereby the space required in carrying out the various steps is reduced to a minimum.

The invention further contemplates the pro-

vision of a novel method wherein the making of the molds, the pouring and the handling of the poured molds are so correlated that the



three operations can be carried out with great rapidity and continuity while at the same time provision is made for accommodating and temporarily storing a large number of poured molds in such manner as to utilize but little more space than would be required for a single mold of an approximately corresponding size.

Patent No. 1,128,481—*Amalgamating or Plating Machine*.

C. G. Miller, Chicago, Ill. Filed Feb. 16, 1915. Serial No. 709,869.

The object of this invention is to provide a galvanizing or plating machine so constructed as to permit structural bars, pipe or other materials of any desired length (depending merely upon the dimensions of the machine) to be treated continuously and

progressively and to insure absolute uniformity in the result.

It is also an object of the invention to provide means for freeing the bars from hydrogen bubbles practically as formed, and to subject every portion of the bar or object treated to exactly the same action.

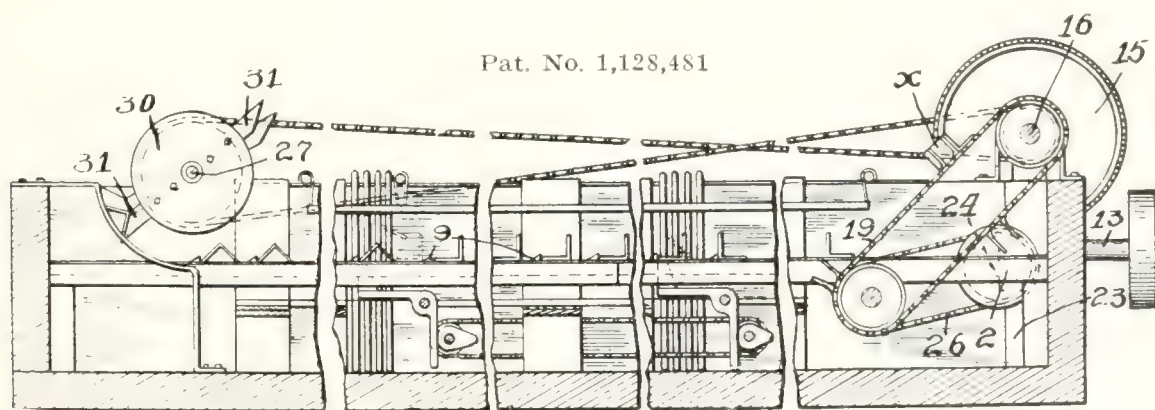
Another object of the invention is to form an exceedingly strong, simple and durable machine for the purpose specified, consuming but slight power and acting to automatically deliver the bars in the desired position into the machine and also automatically deliver the treated bars therefrom.

Patent No. 1,128,058—*Metallic Coating and Process of Making Same*.

Max Ulrich Schoop, Hongg, Near Zurich, Switzerland. Filed Feb. 9, 1915. Serial No. 552,800.

This invention relates to homogeneous metal layers or coatings on articles of various kinds and the process of making same, which coatings may be extremely tenacious, or capable of being removed.

The fundamental idea of the invention consists in that the metal is applied to the surface to be treated, for example articles of metal, wood, paper, fabric and the like, in a finely divided molten or plastic condition, and to this end is sprayed, projected or blown onto the surfaces to be coated by means of a suitable agent capable of exerting the required pressure, or of atomizing the metal. This agent may be either high pressure steam, hot compressed air, or any other gas or vapor under sufficient pressure to atomize the metal in a suitable atomizer, whether heated or not. Instead of atomizing the metal, the liquid metal may be projected onto the surface to be coated in very fine or capillary streams, or a number of streams united to form a spray, there being used for the purpose one or more nozzles of suitable form through which the molten metal is forced.



CIRCULAR OF THE BUREAU OF STANDARDS ON REGULATION OF ELECTROTYPING SOLUTIONS*

COPPER SOLUTIONS

The solutions usually employed for copper electrotyping contain, in addition to water, only copper sulphate and sulphuric acid. Since these substances and also the anode copper are usually fairly pure, there is no marked tendency for impurities to accumulate in the solution. The principal changes taking place in the composition of such solutions are due to two causes, (1) mechanical loss of the solution adhering to the "cases" (cathodes) when removed from the vats, and (2) solution of a greater amount of copper from the anodes than is deposited on the cathodes. The first factor would in itself cause a decrease in the density of the solutions, if, as is customary, the level of the latter is maintained approximately constant. (Water should be added to the vats at intervals in order to replace that lost by evaporation.) The second action will cause a decrease in the acidity and an increase in the density of the solutions, owing to a consumption of sulphuric acid with the production of a corresponding amount of copper sulphate. In all cases thus far observed, the latter effect is predominant. The exact causes of this consumption of acid and the best method of reducing or eliminating it are now the subjects of investigation by this Bureau.

In general, it is necessary at intervals to determine and correct the composition of the solution. The mere determination of the density of such solutions, whether with a Baumé or specific-gravity hydrometer, is not sufficient to fix their composition. If, however, the density of the solutions and also the amount of free sulphuric acid present are determined, the composition is fixed. Thus, for example, a solution with a specific gravity of 1.16 (20 deg. Baumé) and containing 45 grams per liter (6 ounces per gallon) of free sulphuric acid has a perfectly definite and reproducible composition. The above figures do not, to be sure, indicate the amount of copper sulphate present in such solution, but this is of no consequence to an electrotyper except when he is preparing a new solution. For such cases tables showing the amount of copper sulphate

required to produce solutions of any desired density, with any specified acid content, would be desirable, and will probably be prepared for some future edition of this circular.

The Bureau is not yet able to recommend any composition of the solutions as best adapted to any given conditions of operation. In various commercial solutions thus far tested the specific gravity ranges from 1.12 (15.5° Bé) to 1.20 (24.2° Bé) and the acidity from 25 g/l (3.3 oz./gal.) to 90 g/l (12 oz./gal.). In general, the lower the voltage employed the more acid is required to produce a given current strength and rate of deposition, and vice versa. For the present, each operator should find a composition of solution which will give him satisfactory results under his conditions, and maintain it as nearly constant as possible by adjusting the density and acidity of the solutions at regular intervals (e. g., once a week) by the methods described in the following sections.

Density.

Before testing the solutions they should always be adjusted to the normal level of the vats by the addition of water if necessary, and thoroughly mixed. The hydrometer should always be read in the same way, preferably by floating it in a glass jar or cylinder containing the solution. By placing the eye slightly below the level of the solution, and then gradually raising the eye, the surface, first seen as an ellipse, becomes a straight line, the intersection of which with the hydrometer scale should be taken as the reading of the hydrometer. For practical purposes, and especially for comparison, the readings will usually be sufficiently accurate if made by observing the hydrometer scale above the surface of the liquid. The density should always be taken at approximately the same temperature, preferably 60 deg. F.

Having determined the density of the solution (which will usually be found to be higher than is desired), it may be adjusted to the desired density by the following method, based on the assumption that the excess density of the solution (above that of water) is approximately proportional to the content of the dissolved substances.

(a) *Specific Gravity.*—If a specific-gravity

* Issued by Department of Commerce, Washington, D. C.

hydrometer is employed, divide the difference between the observed and desired specific gravities by the difference between the observed specific gravity and the specific gravity of water, which is 1.000. The result is the percentage of the solution which should be replaced with water.

Example.

Observed sp. gr. 1.179
Desired sp. gr. 1.160

Difference 019

Observed sp. gr. 1.179
Sp. gr. of water 1.000

Difference 179

$$\frac{0.019}{0.179} \text{ or } \frac{19}{179} = 10.6 \text{ per cent.}$$

Therefore, replace with water 10.6 per cent of the solution, or 10.6 gallons for every 100 gallons in the vat.

(b) Baumé.—If a Baumé hydrometer is used, the calculations are even simpler, and for practical purposes are sufficiently accurate. In this case we simply divide the difference between the observed and desired density, in degrees Baumé, by the observed degrees Baumé, to obtain the percentage of the solution to be replaced with water.

Example.

Observed deg. Bé. 22
Desired deg. Bé. 20

Difference 2

$$\frac{2}{22} = \frac{1}{11} = 9.1 \text{ per cent.}$$

Determination of Acidity

(a) Principle.—The amount of free sulphuric acid in the solution is determined by measuring the volume of an alkali solution of known strength which is required to neutralize the acid present in a measured volume of the solution. An indicator (methyl orange) is added to the solution in order to show, by its change in color, when all the acid is neutralized by the alkali. The method as applied to such solutions is not original, having been

published by Wogrinz in 1913. Even before that time it was used in a few electrotyping establishments in this country.

(b) Apparatus.—The only essential pieces of apparatus for making this test are a pipette to measure the copper sulphate solution, a burette to measure the standard alkali, and a few bottles. Fig. 1 illustrates a form of apparatus that has been found convenient in this work. Doubtless many other forms of

- A 2 Liter bottle.
- B 25 cc burette with side stop cock.
- C Atomizer bulb
- D 10 cc pipette.
- E 500 cc bottle
- F Pipette about 2 cc
- G 100 cc flask.

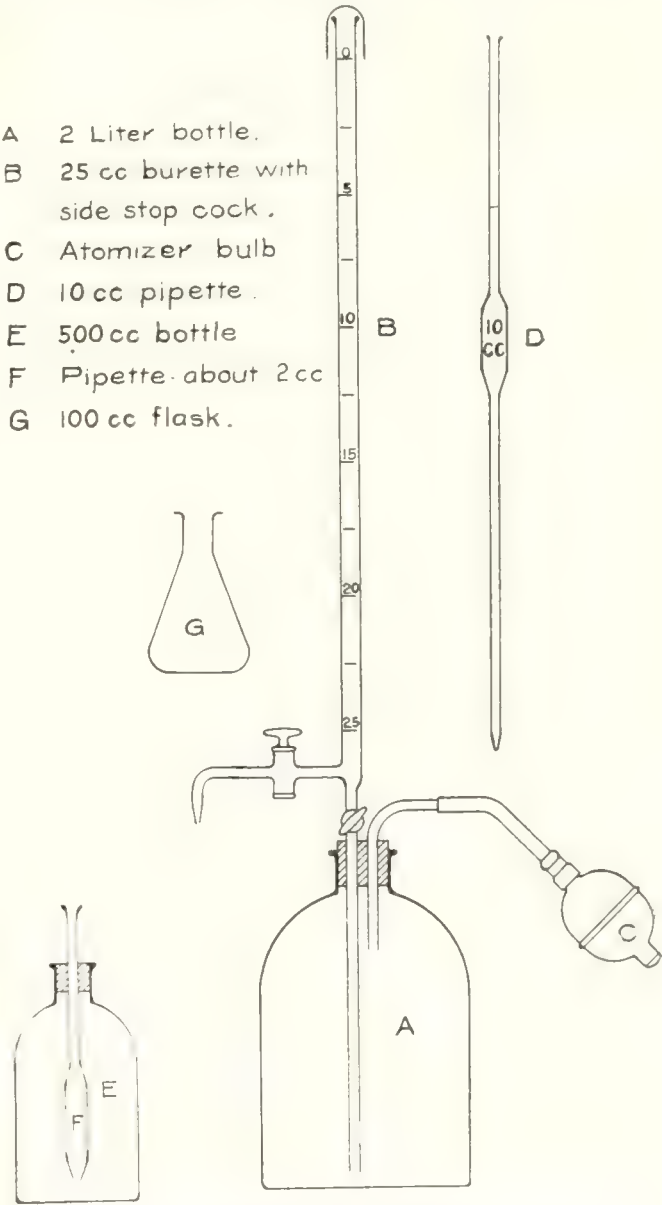


Fig. 1. Apparatus for testing acidity

reservoir burettes will be found equally suitable. The apparatus and also the necessary solutions can doubtless be secured for a moderate charge from any local chemist or chemical supply house.

Solutions—(a) Alkali.—A sodium hydroxide (caustic soda) solution of any known and convenient strength may be employed. In the preliminary circular a solution prepared of a strength (0.61 normal) equivalent in the titration to 3.0 grams per liter of sulphuric

acid was suggested. In view of the greater ease of securing a normal solution of sodium hydroxide we now recommend the use of a *normal* solution. One cubic centimeter (1 c.c.) of such a solution will neutralize 0.049 gram of sulphuric acid. If, therefore, a sample of 10 c.c. (or 1/100 of a liter) of the copper solution be titrated, each cubic centimeter of the sodium hydroxide required is equivalent to 4.9 grams per liter (or for most practical purposes 5 g/l or 0.67 oz/gal.) of sulphuric acid. Solutions of other strength may be employed, provided the calculations be correspondingly changed. Since the sodium hydroxide may change in strength on standing (owing to its attacking the glass of the container) it should either be renewed, or restandardized by a chemist, at intervals of about six months.

(b) Methyl orange solution (1 part methyl orange in 5000 parts water) which serves as an indicator, i. e. it changes color when all the sulphuric acid is neutralized.

2. Titration.

To carry out the titration, measure with a pipette 10 c.c. of the copper sulphate solution to be tested (after the bath has been adjusted to the desired specific gravity and thoroughly mixed), and run it into a small flask. Add to it about 2 c.c. of the methyl orange solution. To adjust the sodium hydroxide solution to the zero mark in the burette, turn the center stopcock so that the burette is connected with the stock bottle, and with the bulb pump the solution till it is above the zero mark, and then shut off this stopcock. Next turn the side stopcock and allow the solution to run into any convenient vessel (for waste) till all air is displaced from the side tube and the lower edge of the curved surface of the liquid is just at the zero mark. Now run the sodium hydroxide solution into the copper sulphate solution slowly with constant shaking, until the violet color of the solution just disappears. If a decided green color, or appreciable precipitate appears, too much alkali has been added and a new portion should be titrated. Note the position of the lower edge of the curve at the end of the titration.

3. Calculation.

To find the number of grams per liter of sulphuric acid in the copper solution, multiply by five, the number of c.c. of alkali used in the above titration. To find the number of pounds of acid to be added for each 100 gal-

lons of the bath, deduct the amount of sulphuric acid thus found, from the prescribed content, and multiply the result by 0.83. (Since one gallon is equal to 3.79 liters, or 100 gallons equal 379 liters, we multiply by 379 the number of grams per liter required; and since there are 454 grams in one pound, we divide the last result by 454. For practical purposes therefore we multiply by $379 \div 454$ or 0.85. For any given capacity of tank, the correct factor can be readily determined.

Example.—Suppose 10 c.c. of the copper solution requires 9 c.c. of the alkali in the titration. Then the solution contains $9 \times 5 = 45$ grams per liter of acid. If, for example, we desire to have present in the solution 60 grams per liter of acid, it is necessary to add $60 - 45$ or 15 grams of acid for each liter of the solution. For a vat holding 100 gallons we must add 15×0.83 (or $15 \times 5/6$) = 12.5 pounds of acid. Or, if the vat holds, for instance, 180 gallons, we use the factor $180/100 \times 0.83 = 1.49$; i. e., we must add $15 \times 1.49 = 22.4$ pounds of acid.

(f) *Notes.*—1. In the above operations and calculations extreme accuracy is not required, since all that can be accomplished is to keep the composition of the solutions approximately constant. The chief value of such tests will be to enable the operator to avoid obtaining defective work, or, in cases where the work may prove defective to determine immediately whether the composition of the solution or some other condition is at fault.

2. A permanent record of all titrations and of all changes in or additions to the solutions should be kept. Such records will ultimately furnish valuable information regarding the operation of the bath.

Nickel Electrotyping Solutions.

Owing to the great variations observed in the composition of solutions employed in nickel electrotyping which yield fairly satisfactory results, it is impossible to state at this time the best composition of the baths or the best methods of operation. Obviously, the object of work in this field should be to determine the simplest solution which will give satisfactory results and to devise methods for controlling its composition. Additions of such substances as sodium chloride, ammonium chloride, boric acid, vanadium salts, etc., render the testing and adjustment of the solutions far more complicated, and should not be used except so far as it can be shown that any beneficial effect exerted by them outweighs the above objection.

COPPER CYANIDE PLATING SOLUTIONS*

BY DR. MAX G. WEBER

(Concluded from page 111, March issue)

The first part of this paper has shown that the constituent which is essential in a copper cyanide bath is the double salt, sodium copper cyanide, consisting of copper cyanide and sodium cyanide and which is easily formed by adding the necessary amounts of each chemical to water. A high-grade sodium cyanide has been obtainable for quite a number of years, but copper cyanide could only be procured at prices which made its use prohibitive for technical purposes. For this reason many salts—one might call them subterfuges—have been used which were intended as a substitute for copper cyanide, forming this salt when brought together with cyanide solution. One should bear in mind that whatever copper salt is brought together with sodium cyanide solution, the final compound is the double salt, sodium copper cyanide. Another fact which should not be lost sight of, is that one chemical can replace another only to the extent of the requisite elements, and that by the reaction of two such salts, a by-product is always formed which contaminates the compound desired. This is the case with the copper cyanide. Copper carbonate, copper sulphate, copper acetate and cupri-cupro sulphite have all been employed in order to form copper cyanide by mixture with sodium cyanide and water. That by these reactions an inert by-product consisting of sodium sulphate or sodium sulphite or sodium acetate or sodium carbonate is formed to a high percentage, every one was aware of, but took it for granted, as the product necessary, copper cyanide, was not obtainable commercially. When using copper carbonate, which is really basic copper sulphate containing a small percentage of carbonate, according to the temperature at which it is precipitated, approximately one-half pound of inert matter is formed for every pound of copper carbonate, consisting of sulphates and carbonates. By the use of copper acetate, or cupri-cupro sulphite this inert matter is still further increased, and for each pound of the compounds used, from nine to ten ounces of inert salts are produced.

These salts accumulate in the bath more and more with every addition of the respective copper salt, and finally yield such a dense solution, overloaded with these waste compounds, that it cannot be worked in a satisfactory manner any longer as plated articles are blistered, and the solutions are of necessity discarded. The reason for this is that a bath of this kind has a relatively low metal concentration and a much higher one of the inert salts. As a rule, the electric current deposits the metal easiest to discharge, which in this case, is the alkali metal. As the current density increases, an excess of hydrogen is generated, which causes burning and the current output drops considerably.

After considering this crude method of forming copper cyanide one should remember that the copper in a cyanide plating solution is in the cupro state, while copper carbonate, copper sulphate and copper acetate are cupri salts, and cupri-cupro sulphite is a mixture of both. This means that these salts must be first reduced to the cupro state before they are fit for plating. This reduction is executed at the cost of the sodium cyanide, which is actually intended for bringing the copper metal into solution only. Further, neutral copper salts as copper acetate, copper sulphate and cupric sulphite, when brought in contact with cyanide solutions first form cupric cyanide, which, being an unstable compound, decomposes into cuprous cyanide and cyanogen. The latter escapes into the air, and on account of its highly poisonous character, is most detrimental to the health of the plater.

Taking into consideration all the disadvantages resulting from the present method of producing a plating solution, every progressive plater should greet with joy the fact that a chemically pure cuprous cyanide is now on the market at a price making its use more economical than that of any other copper salt. This has been accomplished by new manufacturing methods worked out by the author of this article.

Cuprous cyanide contains nothing but the ingredients necessary in a plating solution—copper and cyanogen—so that by dissolving

*Paper read at the Lewis Institute, Chicago, Ill.

it in cyanide solution no inert, unnecessary products are added. This enables the plater to have perfect control of his solutions at all times, as whenever metal is needed, he adds it in the form of copper cyanide, and when cyanide is needed, he adds sodium cyanide, thus simplifying matters. On account of its high percentage of metal—it contains 70 per cent pure copper, the rest being cyanogen—solutions highly concentrated in metal can be worked at a relatively low specific gravity. This is a further advantage, as a bath low in density is much more easily controlled than a very concentrated one.

Copper cyanide being a cuprous salt, does not consume any cyanide in order to be transferred to the cuprous stage, and because of its being a cyanide itself, it requires less sodium cyanide than any other copper salt to yield the double salt, sodium copper cyanide, the essential constituent of a plating solution. This fact points out a more economical method for producing a plating solution. In other words, it saves money. When one buys a metal salt for plating, one should not forget that it is not the price of the metal in the salt itself which constitutes the economy of the salt, but the price at which the metal is put into solution as a double cyanide. It is this economy of the copper cyanide, combined with its high technical qualities, which makes copper cyanide superior to any other plating salt.

The following figures give a comparison of plating solutions produced with different copper salts, and are the results of actual tests. The metal contents of the following solutions are the same:—

Copper Cyanide, 70 Per Cent. Copper:

100 lb. Copper Cyanide, @ 42c. per lb.....	\$42.00	
100 lb. Sodium Cyanide, 129 per cent., @ 22c. per lb.....	22.00	
		\$64.00

Copper Carbonate, 50 Per Cent. Copper:

140 lb. Copper Carbonate, @ 14c. per lb.....	\$19.60	
280 lb. Sodium Cyanide, 129 per cent., @ 22c. per lb.....	52.58	
		72.18

Cupri-Cupro Sulphite, Termed Red Copper Compound—40 Per Cent. Copper:

175 lb. Red Copper Compound, @ 30c. per lb.....	\$52.50	
160 lb. Sodium Cyanide, 129 per cent., @ 22c. per lb.....	35.20	
		87.70

Copper Acetate, 31 Per Cent. Copper:

220 lb. Copper Acetate, @ 25c. per lb.....	\$44.00	
193 lb. Sodium Cyanide, 129 per cent., @ 22c. per lb.....	42.46	
		86.46

After continuous operations for two hours it was found that while the solution made up with copper cyanide remained almost constant, that is, the relative proportion of metal and cyanide were practically the same, the solution made up with the other salts became unbalanced. The anodes coating over required further additions of cyanide, showing once more that solutions made up with chemically pure copper cyanide gave maximum efficiency.

As so-called copper carbonate was the most extensively used, I gave this solution special attention and found, after considerable experimenting, that in order to obtain a solution with sufficient free cyanide to obtain a fairly balanced solution the following proportions were necessary:—

140 lb. copper carbonate, @ 14c. per lb..	\$19.60
280 lb. sodium cyanide, 129 per cent., @ 22c. per lb.....	61.60
	\$81.20

These comparative figures vindicate once more one of the most important rules in chemistry—that pure materials not only give the greatest efficiency, but are the most economical.

At the present day, which is distinguished by the endeavor to obtain an end as simply as possible, where everything is standardized in order to obtain the best results at the lowest cost, no far-sighted man can dispute the fact that metal cyanides bring this desired standardization to the plating industry, which means the utmost economy and the highest results.

Charles Proctor, New York City, then gave a practical demonstration of the working of

metal cyanides in plating representative products of leading Chicago manufacturers, including steel hinges, antimonial lead soda fountain spouts, cast-iron products, etc. The demonstration was a complete success and the finished goods were passed through the audience for inspection. A lively discussion followed which lasted more than an hour and

every opportunity followed was given by the lecturers for a thorough consideration of the different points involved in the discussion. The demonstration outfit was subsequently presented to the Lewis Institute for further research along these lines through the courtesy of the Roessler & Hasslacher Chemical Co., New York City.

HISTORY of CELLULOSE LACQUERS

By E. N. TODD*

While Hanson & Van Winkle Company was busy experimenting in Newark and Richard Hale was operating in Springfield, N. J., endeavoring to produce THIN solutions of nitro-cellulose, John Stevens, in the employ of the Celluloid Co., was making investigations in the manufacture of SOLID compounds of nitro-cellulose. These experiments were productive of results rich in benefits to manufacturers and to mankind, as they were the basis for the establishment of extensive industries in the manufacture of lacquer; great improvements in the manufacture of transparent celluloid and vast changes in the art of photography. It was from the Hanson & Van Winkle Co. that the Rev. Hannibal Goodwin, the inventor of the transparent flexible film used in cameras and moving picture machines, obtained the material from which the original film was made. It was the investigations of Richard Hale that led to the manufacture of imitation leather from pyroxylin compounds, and it was through the discoveries of John Stevens that the transparent medium used to replace glass in automobiles was made commercially possible.

All of these factors working along similar lines within ten miles of one another were unaware of this fact, and were for years personally unacquainted with one another and with Hannibal Goodwin, who was experimenting at the same time in the rectory of the House of Prayer, Newark, N. J.

Although the "Stevens" patents were issued in 1882 it was not until 1885 that the Hanson

& Van Winkle Company's attention was called to the fact that they were infringing. Overtures were made to the Celluloid Company, the owners of the "Stevens" patents, for a license to operate under them and as a result of these negotiations a license was obtained and the Celluloid Varnish Co. was formed by the purchase of the established lacquer business of the Hanson & Van Winkle Co. The Celluloid Varnish Co., was established at the corner of Chestnut and McWhorter St., in Newark, N. J. and was the first company in the world organized to manufacture and sell thin solutions of nitro-cellulose to be used as a lacquer or varnish for the preservation of metals.

The interest of the Hanson & Van Winkle Co., in collodion lacquers was intensified, not only by the fact that the original experiments had been made on their premises, but the company foresaw that the use of transparent lacquer, which would not mar or discolor the brightest surface, but would retain the full perfection of highly finished metal, would in the course of time become a commercial necessity and they continued to act as agents for the Celluloid Varnish Company.

In 1887 Julia Hale, executrix of Richard Hale, who probably did not know of the "Stevens" patents, made application for a patent for pyroxylin varnish, Richard Hale having died from the effects of an explosion in his laboratory while experimenting in the manufacture of the non-hygroscopic solvents of pyroxylin.

A long and costly litigation followed between the Celluloid Varnish Co., and the

*Vice-President of the Hanson & Van Winkle Co., Newark, N. J.

Frederick Crane Chemical Co., owners of the "Hale" patent, which probably interfered with the development of the business for many years and had a tendency to increase the cost of Celluloid lacquers, as they came to be known, and to prevent their general use.

The owners of the "Hale" patent finally confessed judgment to the Celluloid Varnish Co., and a new company was formed purchasing the established business of the Celluloid Varnish Co., and the Frederick Crane Chemical Co., and receiving a license under the "Stevens" patent. The company so formed is still in existence and is a large manufacturer of thin solutions of nitro-cellulose.

From 1882 to 1899, when the "Stevens" patents expired, the growth of this industry was remarkable, and shortly before or after the expiration of the patents, several competitors of the original companies appeared upon the field and introduced their wares not only to the manufacturers of metal articles but for the manufacture of artificial leather, the finishing of patent leather, the coating of incandescent mantles and the production of transparent flexible films used in photography and for moving pictures.

In the early days lacquers were sold at a high price, as the expense of original research and educational work, the costly litigation, together with the difficulties of producing the new solvents, tended to keep the cost of production high. With the increasing demand, the increasing competition and a more general knowledge of the principles governing the manufacture and use of these solvents, which brought this industry and product within the reach of all; the operation of the laws of supply and demand would naturally, one would think, have a tendency to reduce the cost.

Strange as it may seem, in this particular industry the operation of the law of supply and demand greatly increased the cost, as the demand soon greatly exceeded the supply, for the following reasons. The material used for the production of the necessary solvents is a by-product in the manufacture of ethyl alcohol, which by-product at the date of the "Stevens" patents had no value and was thrown away by distillers. The writer has invoices for this material from distillers at ten cents per gallon and has survived to see the price advance to \$2.00 per gallon at which price the by-product is worth ten times the value of the material from which it is separated.

The demand for this material exceeded the

supply in the United States as early as 1890, and by 1900 the demand exceeded the supply in every country of the world. Without doubt this question has received the attention of all manufacturers of alcohol and has been the subject of research and experiment by chemists and inventors, but up to date—January 1st, 1915—without any appreciable result.

This industry, with such a small beginning, has undoubtedly come to stay, and the introduction of nitro-cellulose in the arts and trades has increased daily and would still further increase if the fundamental difficulty of obtaining raw materials was overcome. In Russia and Germany, where the manufacture of alcohol for use in the arts and trades is liberally encouraged, and in the United States where alcohol by the use of denaturants is made accessible to consumers, the increase in the demand for alcohol has not resulted in any relief in the production of the by-product.

The unfortunate conditions in Germany and Russia, (where the greatest amount of alcohol is produced from potatoes), due to the war which is raging, has still further affected the production and exportation of this product, and consequently present prices are far above normal and will probably go much higher.

Again we face the problem of the hour and we look for the man.

Having been intimately acquainted with the growth of this business and these conditions the writer is tempted to indulge in prophecy as to the future and to advice in which direction to look for the man.

When someone comes around and offers to show you how to use solutions of nitro-cellulose for lacquer, other than the ones you are using, do not put him out; recall this tale of his troubles in inducing you to use what you now use. Preserve the Missouri attitude of mind, but do not refuse to "let George do it" if he offers. He is sure to come!

The BRASS WORLD AND PLATERS' GUIDE is well worth the moderate subscription price (\$1.00 a year in the U. S.) to any firm or individual interested directly or indirectly in the working of the non-ferrous metals or in electroplating.

One subscriber writes us "Every issue of the BRASS WORLD is worth the full subscription price—as I get something of real value in every number."

If you think any of your friends would like to subscribe, send their names to us and we will be pleased to send them a sample copy together with a subscription blank.

Ney Solders Give Credit Where Credit Belongs

The J. M. Ney Co., Hartford, Conn., has been in business over 100 years and its business is to join things together. Hence the Ney solders. This faculty for assiduous research and consideration of detail is evidently not confined to solders for the founding of metals but also has been applied to the joining of historical facts.

Congress is endeavoring to decide whether John Fitch of Windsor, Connecticut or Robert Fulton of Pennsylvania "discovered the means of successful application of steam propulsion of vessels through water."

A bill was introduced in the House of Representatives in Washington on April 7th, 1913, by Hon. William W. Griest, of Lancaster, Pa., proposing a national appropriation of \$20,000 for a memorial to Robert Fulton at his birthplace in Pennsylvania. Probably much controversy will now attend the debate which will occur in connection with the bill.

The J. M. Ney Co. was first to give to those interested, indisputable evidence that neither John Fitch nor Robert Fulton is entitled to any credit, but that William Henry of Lancaster, Pa., was the first discoverer and inventor of the steamboat. This was done in the Ney advertisement in a dental journal.

Fulton's "Clermont" was launched only in 1807, five years before the Ney Co.'s business was started in what is now a large city but was then a hamlet. Fitch did not procure his patent until 1791, but William Henry launched his little steamboat on the Conestoga River in 1763, forty-four years before the "Clermont" appeared, and 18 years before Fitch got a patent. From this interesting advertisement we excerpt the following paragraphs, which combine historical interest and sound advertising most wisely:

"William Henry, the patriot, of Lancaster, Pa., built in 1763 the FIRST steamboat and tested it on the Conestoga River. Narrow-minded men said, 'He can never do it.' Broad-minded civilians said, 'It seems too wonderful, but let's SEE FIRST and talk afterwards.' They went to the river bank and saw. Credit is given to Robert Fulton for having invented the first steamboat, the 'Clermont'. But the records of the American Philosophical Society show that William Henry was the FIRST inventor. His paper

describing The Sentinel-Register appears in its Transactions. Twenty-two years LATER John Fitch called on Henry, having taken Robert Fulton with him. Both men saw what Henry had done. Fitch improved on Henry's model and Fulton improved on both. But neither Fitch nor Fulton was honorable enough to give William Henry the credit. The fullest proof to show Henry's priority is given in a book written by Francis Jordan, Jr., several years ago, entitled, 'The Life of William Henry of Lancaster, Pa.,' 1729-1786.

"William Henry should have used printers' ink to announce his discovery to the world. Too late did he realize his mistake in not doing so. We will not make a similar mistake and therefore our trademark says, 'The Pioneer.' Not that we covet glory! Instead of your recognition of our priority in the Dental Gold and Solder fields, we would much prefer your orders. That ours is The First American Gold Refinery is a matter of history."

In "The Life of William Henry", referred to above, he is called Patriot, Military Officer, and Inventor of the Steamboat. This book makes clear that the memorial should be erected to William Henry as he alone is entitled to the credit. It is probable that Representative Griest will withdraw his bill and offer a substitute, in which the name of Fitch and Fulton will not appear. The most remarkable feature in this case is that Mr. Griest comes from the very city in which William Henry lived and gave vast assistance to his fellow-countrymen during their long struggle against invaders. It must be a sore blow to Lancaster that it should receive instruction from Hartford concerning its claim to national celebrity.

The production of important metals in the United States for 1914 as compared with 1913 is estimated by the Engineering and Mining Journal as follows:

	1913	1914
Aluminum, lb.	49,601,500	45,000,000
Copper, lb.	1,225,735,834	1,135,730,818
Ferromanganese, gross tons	229,834	172,514
Lead, net tons	433,476	533,373
Nickel, lb.	47,124,330	30,067,064
Zinc, net tons	358,262	360,689

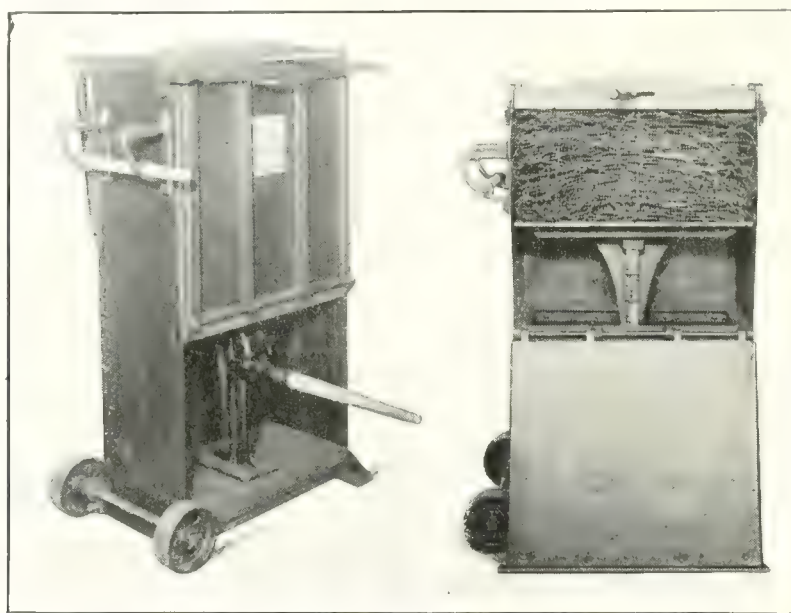
The K. & B. Baling Press and Truck

The economical disposal of waste metal of a tangled or frowsy nature has been a problem confronting the trade for a great many years. Scrap metal dealers are compelled to take quantities of this character of material in order to secure the heavier and more easily handled stock, and after getting it to their yards either allow it to lay around and thus occupy valuable room, or dispose of it in an unprofitable manner.

The K & B Co., 25 N. 7th St., Philadelphia, Pa., has perfected a line of baling presses specially adapted for handling such stock. Where the accumulation is large, that is, say 20 tons or more per day, a power-driven machine is available; where comparatively small quantities are to be handled, the baling truck illustrated herewith takes care of the conditions to perfection.

facturers, foundries (for busheling or cabbaging work), etc.

The truck is built of steel, is very simple in operation and very substantial of construction. The charging box is 24 in. long, 12 in. wide and 24 in. deep; outside dimensions of the machines are 32 in. wide, 22 in. deep and 52 in. high. In operation the cover is thrown back, material placed in the hopper and rammed down; when the hopper is filled the lid is closed down and securely locked by the lever shown at the front; pressure is then applied from underneath by a simple hoisting mechanism having a capacity of producing 5 tons pressure. This pressure will reduce the contents of the hopper about one half. While the pressure is on the material the front door is opened, and tie wires laced through the slots as in an ordinary baling press. The contents of the finished bale are approximately



This truck has applied itself particularly to the requirements of plants which unpack baled materials, including paper mills, textile manufactories, cork works, oil cloth manufacturers, etc., for packing the bale ties. The usual method of disposing of these ties has been to carry them to the dump, or pile them in the vicinity of the mills, where they become an unsightly and unprofitable mess. With the truck at the point where bales are opened, the ties are neatly put up in bales and become a source of revenue instead of an expense; it requires less labor to bale the stock in this manner than it does to handle it in the old way. The truck has also been used successfully by manufacturers of light stamped metal goods, covered-button manu-

two cubic feet, and weight, depending somewhat on the character of the stock, will vary from 100 to 150 lb. Special information on the adaptability of the machine for individual conditions can be obtained from the company.

Electroporcelain, or porcelain ware decorated with silver designs by electrodeposition, is said to be popular in Germany. It is cheaper than plated silverware, and wears better than either porcelain or solid silver.

Segregation, to which bronzes rich in lead are liable, is prevented by the addition of 1 per cent nickel, sulphur added as galena, phosphorus or arsenic.

CLASSIFIED ADVERTISEMENTS

Undisplayed advertisements for Help Wanted or Situations Wanted not exceeding fifty words, single insertion—fifty cents; three insertions for one dollar. Two cents for each additional word. Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars. If in display type—two dollars per inch, each insertion.

Help Wanted.

GOOD OPENING for energetic man to take charge of brass foundry department in smelting works. Must be capable of handling men and familiar with mixing metals. Molding experience not required, but must have thorough knowledge of brass foundry practice and know how to run various styles of furnaces. Man with reverberatory furnace experience preferred. Address "WESTERN," care of The Brass World Publishing Co., Edison Building, New York.

WANTED AT ONCE—An experienced plater, one who is thoroughly familiar with electro-galvanizing, brass, gold, nickel and silver plating, also fancy finishes on brass and steel. Must have some cleaning and rolling room experience. In writing, state age and give references. Box No. 1014, Waterbury, Conn.

SALESMAN WANTED—A concern making a superior line of buffing and polishing compositions requires representative for New England and New York State. Must be acquainted with the metal manufacturing trade and must be able to sell the goods. Attractive terms will be offered to the right man. Address "SALESMAN," care The Brass World, Edison Building, New York.

Situations Wanted.

BRASS and aluminum foundry foreman. Up to date on molding machines and first-class metal mixer for any class of work. Good handler of help; highest references as to ability. Address "METAL MIXER," care of Brass World Publishing Co., Edison Building, New York.

A BRASS FOUNDRY FOREMAN is open for engagement. Have had 20 years' experience in plumbers' supplies, valve work, builders' hardware and general jobbing. (Reference.) Address "VALVE," care of Brass World, Edison Building, New York.

FOREMAN PLATER or to take charge of polishing and buffing department. Experience in brass, nickel, copper, silver and gold. Address "FOREMAN," care of Brass World Publishing Co., Edison Building, New York.

WANTED.—Competent man, capable of taking charge of plating, polishing, buffing, bright dip and lacquer departments, etc. Fully experienced and can furnish first-class references. Address "MICHIGAN," care BRASS WORLD, Edison Bldg., New York.

Wanted and For Sale.

FOR SALE—12,000 japanned malleable iron valve wheels or handles. Neat ball pattern, 2 inches diameter, 5/16 inch square hole in center. Write for sample. Ohio Grease Co., Loudonville, Ohio.

FOR SALE.—Baling Press for putting up all loose material in bales. Brand new and a bargain. Address "BALING PRESS," care BRASS WORLD, Edison Bldg., New York.

WANTED—A second-hand plating barrel outfit for nickel, capacity of tank 50 gallons. Advise condition and price. Write "PLATING BARREL," care of the Brass World Publishing Co., Edison Bldg., New York.

The Best Books

Devoted to the Metal and Electroplating Industries are those listed below. Any of these books sent post paid on receipt of price. Any technical book not included in this list can be furnished by us at publisher's price.

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Antimony. By Chung Yu Wang.....	4.00	Metallic Alloys. By G. H. Gulliver.....	3.25
Brass Founders' Alloys. By John F. Buchanan	2.00	Manual of Hard Soldering. By Harvey Rowell	.75
Celluloid: Its Manufacture, Properties and Uses. By Dr. F. Bockmann.....	2.50	Mechanical Engineers' Pocket Book. By Wm. Kent.....	5.00
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Mr. Chas. Vickers Becomes Editor of Our Metallurgical Department

We are pleased to announce that the Metallurgical Department of the BRASS WORLD AND PLATERS' GUIDE will hereafter be conducted under the personal direction of Mr. Charles Vickers, as editor of that department. This announcement will doubtless be pleasing information to a large number of our readers who are already acquainted with the work and technical writings of Mr. Vickers. In the line of metallurgical work there is probably no other man in the United States so well qualified by reason of special training and wide practical experience to conduct a department that calls for such highly specialized ability.

Mr. Vickers early laid the foundation for his sound and extensive knowledge of metallurgy when he became first initiated into the mysteries and difficulties that beset the worker in metals in the large engineering works in the city of Lincoln, England.

When he decided to come to the United States in 1887, there was little of the knowledge of the brass founders' craft that he had not acquired and stored in his mind for future reference.

It was not long after his advent in this country before his articles, appearing at intervals in the best of the technical journals, attracted considerable attention and became authoritative on the subjects he treated.

From that time up to and including the present he has been actively engaged as a writer and as a brass foundry specialist, devoting his attention particularly to melting practice, alloying, foundry design and equipment, etc.

We believe we are particularly fortunate in securing the services of a man of the calibre of Mr. Vickers as editor of the Metallurgical Department.

Preparing Objects for Polishing and Plating

All heavy greases and oil should be cleaned from large articles either by gasoline, benzine or alkaline baths. Rust and scale also should be removed by pickling, tumbling or sand blasting. It is of advantage to the polisher, for his wheels will stand up longer, thus enabling him to do more and better work.

In order to obtain a deposit which is to acquire high luster by polishing, it is necessary to polish to a perfectly smooth surface.

It is less expensive to add an extra operation in fineing or coloring articles than to try an extra heavy deposit of expensive metal to be cut away on the buffs to produce the high luster.

For many purposes polishing in the tumbling barrel is of great advantage, especially where edges do not have to remain sharp. Articles of different shapes and sizes are best treated together, time being saved thereby. Articles that are rough or contain scale are tumbled in water and emery or sharp sand from 24 to 36 hours; when they are ready to be taken from the barrel they are freed from the water and sand. They are then returned to the barrel with dry sawdust to dry and free from adhering sand or emery. They are again taken from the barrel, freed from sawdust and returned to the barrel with clean dry sawdust. They now remain in the barrel until they have acquired the desired polish, which usually takes about 12 hours. The articles after plating can be polished to a high luster by tumbling in dry sawdust that does not contain tannin from $\frac{1}{2}$ to 6 hours.

In preparing articles for the plating baths the extra time spent in thoroughly cleaning and rinsing all the parts of articles from all rust, scale grease, oils, and polishing compositions the operator will be many times repaid with less blistered and peeled work and his solutions will remain in good working order much longer.

The pitting of articles can be greatly avoided by drawing fine tissue paper or cheese cloth over the top of the plating solutions to remove dust and scum before each batch of work has been brought into it.

Do not clean anode or cathode rods over plating baths. The anodes should be cleaned often, otherwise but little metal will be given off. In order to secure satisfactory results and get the limit of production, the solution as well as everything connected with the operation must be kept up to the highest point of efficiency.

The Technical Outlook

Much of the product of the brass foundry is in small and unpretentious units.

Many non-ferrous plants run almost exclusively to a character of work that, as compared with numerous other foundries, is, as one foundryman bluntly puts it, "mere chicken-feed."

And, because it is divided very frequently into small, and to the superficial view, insignificant pieces, and the tonnage of output not usually running high, the brass foundryman may himself not be impressed with the relative importance of his calling, the substantial progress that has been made and is being made in his industry, and the possibilities that are ahead for greater efficiencies in the combinations of his manifold mixtures and the various methods of manipulating his metal.

No one can reflect for a moment upon the values of the materials the expert in brass uses without complete conviction that he handles and controls expensive substances easily having their worth impaired through any one of many possible oversights that are not always to be clearly foreseen. In fact to the uninitiated there are subtle differences and distinctions absolutely hidden from view, yet forming pitfalls where serious possibilities await the unwary and the uninformed.

Only in the technical journal and the reports of the societies dealing specifically with the scientific advancement of the art do we find light upon these subjects. Men are too busy nowadays to circulate their information in any other way.

Even in the same city and on the same street there is little chance in these bustling days to get together for the free interchange of ideas upon technical questions. And it is only to be expected that neighboring foundries are more or less competitors and, friendly though they be, are perhaps not to be expected to give each other as ready expression of their working ideas as if they were at long range and less impressed by their business relations.

Thus the technical journal frequently, and the scientific society less often, because its publications are usually published at longer intervals of time, are the principal sources of this important and essential intercommunication between practical and progressive foundrymen.

And there is plenty of scope for their efforts. Aside from the difficulty that is to be found in the economical uses of delicate materials that are readily damaged, the constantly increasing demands of more rigid specifications and more diversified opportunities for his product are daily putting new problems up to the foundryman and plater for solution.

To-day the craft is becoming of higher standing than ever among practitioners of the mechanic arts. Old-time plants, with their dark interiors, few isolated flickering gas jets, tangled array of shop supplies, broken barrels, uneven benches, gaping tubs, splintered butts, treacherous flasks, crippled crucibles, uncertain tongs, leaky-walled furnace and the systemless management are giving place to an effectiveness that not only aims at it but hits the target.

Want Advertisements Free

For some time past it has been the policy of this publication to charge a nominal sum for "Situations Wanted" and "Help Wanted" ads. As it is the desire of the publishers, however, to do everything possible to improve the service to our readers, we have decided to publish these ads in the future *without charge* and we feel that this change will be greatly appreciated on the part of a large number of our subscribers.

If you are looking for a position or help of any kind, send in an advertisement describing what you want.

Moulding Machine in the Foundry

The modern moulding machine has been demonstrated a great boon to foundrymen, especially in the plants that manufacture specialty work, but there are advantages in its use that many foundrymen have never considered.

The prime advantage, and the one that receives the most attention, is the output. It is many times that of the moulder when working by hand. This is a very important point, but there are other advantages which also ought to be noted. One of these is accuracy; a careful machine operator will make the castings much more uniform than those made by hand.

Another advantage is the fact that the foundryman can produce good castings without high-priced skilled labor, which is often difficult to obtain when business is active. The item of expense for patterns is also smaller, as the pattern plates on a moulding machine are not subject to the same wear and tear that gated patterns are subjected to when used in a match or follow-board.

Taking it altogether, the moulding machine is about the best labor-saving device that has been placed on the market.

Mixed Metals — English Gear Bronze

The alloy known as English Gear Bronze is a very tough, strong metal, about as hard as it is safe to go with a tin bronze without incurring danger of brittleness. A considerable difference of opinion exists as to what percentage of tin in copper constitutes the strongest bronze. Some authorities consider an alloy with 9 per cent. tin and 91 per cent. copper as the strongest bronze, others favor the 10 per cent. tin alloy, and still others claim that alloys having around 15 per cent. tin possess the greatest strength, but when all physical properties of tin bronzes are considered—when hardness, elongation and tensile strength are compared—it will be found that the alloy which we are now considering is a difficult one to beat. It is a fact well known that the hardness of bronze increases with the increase in the tin content, and also that the ductility becomes less, so that alloys containing over 15 per cent. of tin, possess very little elongation. There is a limit of course to the hardening effect of tin, because there is a limit to everything, and this point is reached at about 73 per cent. of copper and 27 per cent. of tin after which the alloys become progressively softer. But long before this point has been reached the limit of the serviceable alloys has been passed, because of their increasing brittleness.

English gear bronze is in great favor with the automobile industry, as a material for axle drive gearing, and when the alloy is made according to the specifications of the Society of Automobile Engineers, the following formula is used.

Copper	89.00	per cent.
Tin	11.00	"
Phosphorus	0.30	"

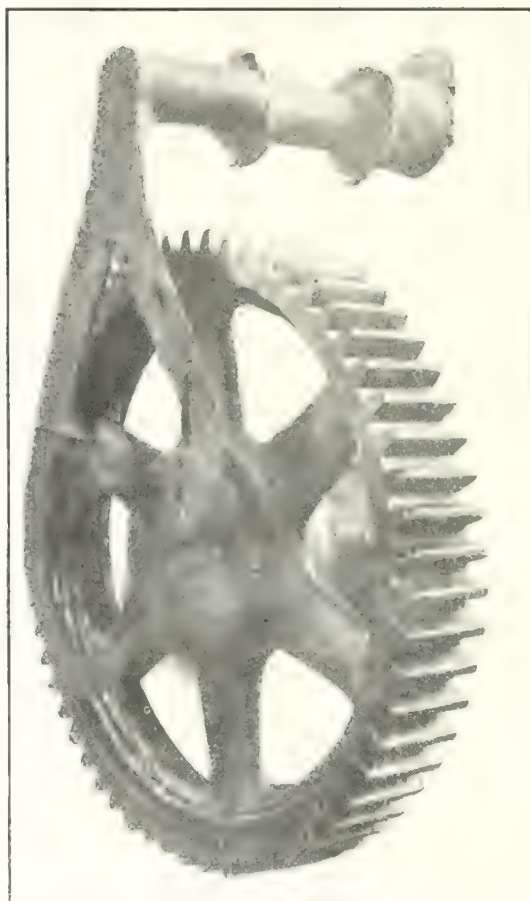
This amount of phosphorus is considered necessary in order to obtain the requisite degree of hardness, although it is more than is necessary to act as a deoxidizer.

The best manner of introducing the phosphorus is in the form of phosphor-copper containing 15 per cent. of phosphorus, therefore, the working formula becomes as follows:

Copper	87.00	per cent.
Phosphor-copper	2.00	"
Tin	11.00	"

In making the alloy the copper should be melted under a good cover of charcoal to

prevent oxidation as much as possible, and when the copper is molten and quite fluid, the phosphor-copper is added and lastly the tin. The reason why the phosphor-copper is added ahead of the tin is that phosphorus possesses a much stronger affinity for oxygen than tin and for this reason it is better to allow the phosphorus to remove as much of the oxy-



Gear with Teeth Cast In

gen that the copper has absorbed in melting as it possibly can before the tin is added, and thus avoid the possible formation of tin dioxide which means loss of tin, and a drop in the hardness and other physical properties of the alloy.

After the additions are all made the alloy should be thoroughly stirred with some implement that will not introduce iron. Apparently the alloy is a very simple one to make, but in reality this is not so, as in spite of the phosphorus, or because of it existing in quantity, the bronze is very susceptible to undue oxidation. This peculiarity precludes the use of scrap and necessitates careful attention during the period of melting, if the highest physical properties inherent in the alloy are to be attained. When properly made the bronze

will possess the following physical properties:

Ultimate strength. 48,000 pounds per sq. in.
Yield Point 25,800 pounds per sq. in.
Elongation 17-18 per cent. on 2 in.
Reduction of area. 18 per cent.
Hardness (Brinell) 82 average
Specific Gravity... 8.83

When the copper has been permitted to oxidize during the period of melting, or if oxidized scrap copper has been used in making the alloy, the fact will be evident in the fracture of the sand cast metal. If a test bar about 1 inch square is broken the fractured surfaces will be mottled with specks of a reddish metal usually clustered around the center of the break, but if much oxide is present the fracture may show reddish streaks and plates radiating from a cluster in the center of the bar. Such metal has been improperly handled when in the furnace, or as before remarked, the copper has been of poor quality, and as a consequence the physical properties of the alloy will be no better than those possessed by a much cheaper alloy, and consequently nothing is gained by the use of such an expensive mixture.

In common with the majority of tin-copper alloys, gear bronze is liable to segregation and liquidation, the one producing an open structure outside of the line of demarkation produced by the chilling effect of the sand, and the other, which manifests itself by an exudation of a rich copper-tin alloy from the heads during solidification, leaves cavities in the castings usually near the gates or risers. The modern method of making gears seeks to counteract these tendencies by the use of chills, usually of iron or steel, which by absorbing the heat from the molten metal cause it to solidify so quickly that no time is given for the formation of alloys of differing melting points and the exudation of the most fusible, which is generally an alloy containing from 19 to 20 per cent. tin phosphorized.

The illustration shows a gear with the teeth cast in and having a very heavy hub cast solid. The gear was gated at the bottom as shown and a heavy riser was taken off in the cope. Gears for automobiles are generally blanks when cast and the teeth are cut by specially designed machines, an operation conducted with such accuracy that gears of any given design are generally interchangeable. Gear bronze is suitable for

many other purposes besides gears, and finds extensive use in all situations where a high grade metal of dependable quality is required.

◆
Effect of Oxyacetylene Welding on Copper Alloys

The micro-structure and mechanical properties of copper and its alloys are deteriorated markedly by Oxy-acetylene welding. Copper becomes coarsely crystalline, while the alloys show a minute heterogeneous structure with discontinuities produced by oxides and blowholes. The tensile strength of copper is reduced by 50 per cent. and the elongation by one-tenth. The strength of the welded joint is not notably improved by such mechanical treatment as hammering, but only by prolonged annealing. Aluminum is affected much less than copper by welding. Its mechanical properties are not altered to any considerable extent, except that the metal is rendered more brittle; the effects of the welding may be removed by both mechanical and thermal treatment of the joint.—Journal of the Society of Chemical Industry.

◆
A New Bearing Alloy

An alloy composed of lead, copper and nickel has been invented by G. C. Holder, Altoona, Pa. (U. S. Patent 1,127,624, Feb. 9, 1915). As much as possible of the nickel it is stated should be added in the form of monel metal the proportion to use being determined by the content of iron and manganese. The following formula is preferred by the inventor.

Lead 61.00 to 77.00 per cent.
Copper 20.00 to 30.00 " "
Nickel 3.00 to 9.00 " "
Iron, not to exceed... 0.50 " "
Manganese, not to
exceed 0.30 " "
Arsenic, optional.... 0.25 " "

◆
Flux for Soldering Aluminum

A new flux for use in soldering or welding aluminum and its alloys has been devised by E. Thaurlow, Frederiksberg, Denmark, who has taken out patents in England and Denmark. This flux, it is said has a lower melting point than aluminum, and is composed of borax 96 parts and sodium bisulphate 4 parts.

FROM AMBER TO DYNAMO

Part VI—The Simple Circuit and Electrical Units

By H. E. Willmore, Jr., B. S.

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The simple circuit consists of a source of potential connected in such a way to a machine, or other apparatus in which electrical energy is expended, as to form a continuous conductive path. The source of potential may be the galvanic cell and the apparatus in which electrical energy is expended may be a plating bath. Any conductor, such as a copper wire, may be used to connect the cell and the plating bath. The statement that the electrical path must be a continuous one is very important. All circuits must be complete loops. Thus, if we trace the electrical path of the simple circuit shown in Fig. 11 from the positive pole of the battery along the copper wire, through the plating solution, back along the other wire to the negative pole and through the battery, we will arrive at the positive pole from which we started. This is the path the current follows. If this path is broken at O the current ceases to flow, and the potential of the entire section of the circuit from P to O becomes that of the positive pole of the battery, while all other parts of the circuit (except the battery electrolyte), including O to A to C to N assumes the potential of the entire section of the circuit. The analogy shown in Fig. 12 should prove useful throughout the discussion of circuits. Fig. 12 represents a water circuit. B in this case, we will say, is a centrifugal pump which raises water from a lower potential cistern, N, to a higher or positive potential, P. From P the current of water flows through the valve O and the turbine T, and back to the cistern, N. From N it is again raised to the potential P, and so on. Crude as this analogy may seem it contains a number of points in common with the simple circuit of Fig. 11, and it is hoped may aid in forming mental pictures of the current flowing in a circuit. We need only a suggestion to understand that unless we

had a cistern of unlimited capacity to draw from and one of infinite capacity to empty the water from the turbine into, the water circuit must form a complete loop in order that it may work indefinitely. The same is true of the electrical circuit. Since we cannot connect the poles of the battery to two bodies of unlimited capacity for electric charges, the electrical path must be a closed loop.

Again, it is not difficult to see that the amount of water flowing through any cross-section of the circuit in Fig. 12 in a given time is the same as that flowing past any other section. This rate of flow we measure in units of gallons per minute, or cubic feet per minute. Likewise, the number of electrons passing all points in the electrical circuit of Fig. 11 in a given time is the same. The simplest method of measuring a charge is based upon the discoveries of Faraday that the mass of an electrolyte decomposed by electrolysis is proportional to the quantity of electricity which passes through it and that the same quantity of electricity will deposit weights of elements, or groups, which are proportional to their chemical equivalents. The unit chosen for electrical charges has been given the name of "coulomb," after Coulomb, who first investigated the laws of attraction and repulsion between electrically charged bodies. We may define the coulomb as that quantity of electricity which will deposit 0.001118 grams (approximately 0.0000394 ounces Av.) of silver. This unit corresponds to the unit gallons or cubic feet in the analogy. Now suppose we assign a new name to a unit for the rate of flow of water which will mean the number of gallons per second. This has been done in the electrical system. When ions are traveling through an electrical circuit at such a rate that, if they kept up the same speed, one coulomb of electricity would

pass a given point in the circuit in one second, we say one "ampere" is flowing. The reader should remember that ampere means a rate of flow and not a quantity. Time is taken into consideration. Thus, in Fig. 12 the water may flow past the valve O at a very high rate, but if it flows for only a short time the quantity of water which has passed will be small. If a steady current of one ampere flows in the circuit of Fig. 11 for one second, a quantity of electricity equal to one coulomb has passed. With a

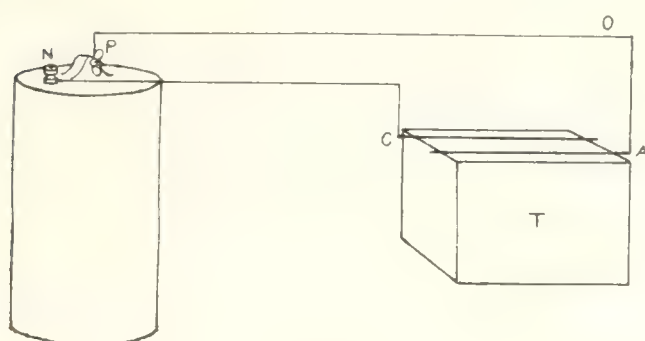


FIG. 11

steady current, therefore, the number of amperes multiplied by the time of duration equals the number of coulombs. Since the rate of flow often varies rapidly, the quantity of electricity must be theoretically measured by the sum of the various rates multiplied by the short periods of time during which the rate of flow was steady. Practically, the mean rate of flow is measured by the ammeter in such cases as the single tank circuit, and this mean result multiplied by the time the current was flowing gives the quantity of electricity which in turn represents a definite amount of metallic ions which have given up their charges. Often only a part of the metallic ions are represented in the metal deposit upon the work from the plating solution, because of the various addition agents which the plater uses to vary the structure of the deposit and its color, and to produce gas bubbles for agitation of the solution in immediate contact with the cathode.

Up to this point no mention has been made of potential differences or resistance in connection with the simple circuit. These have been omitted because it was thought advisable to impress upon the plater the fact that it is the quantity of electricity with which he is concerned. We might go as far as to say that resistance and potential difference are only two counteracting evils as

far as the plating solution is involved. To obtain the proper quantity of electricity, however, we are obliged to study the properties of the electrical path. All conductors, whether solids or electrolytes, offer a certain opposition to the passage of a current, a sort of friction, which we call resistance. We know that when the water flows through the pump (Fig. 12), the friction tends to hold it back with the result that the pressure of the water at P is the pressure exerted by the pump minus that pressure represented by the friction losses. As soon as the water ceases to flow one of two things has happened: the opposition has increased to a value great enough to overcome the pump pressure (such as closing the valve) or the pump pressure has been reduced. As soon as the water ceases to flow the frictional resistance ends but the pipe still retains the property of being able to oppose the flow of water. The same is true of the electrical paths: as long as a current flows they offer an opposition. When the current has ceased to flow they still retain their property of resistance. This property we measure by its effect when a current is flowing. The unit of resistance is called the "ohm." This was named after

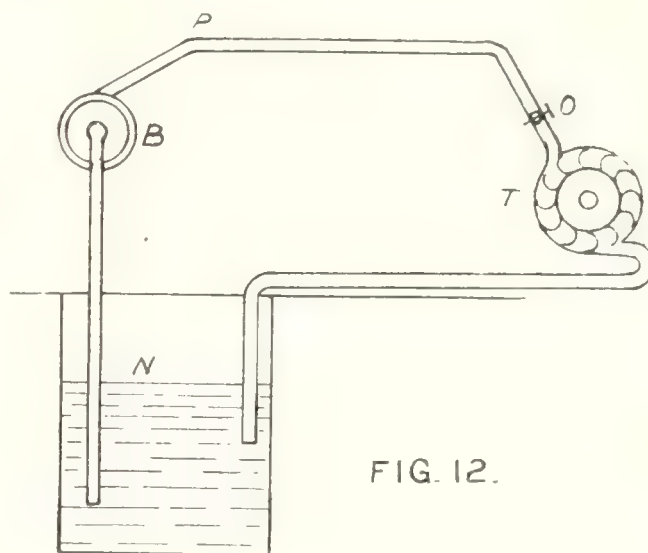


FIG. 12.

the man who first discovered the relation between the magnitude of current, potential difference and resistance. The practical unit of resistance is that of a column of pure mercury 106.3 centimeters long and of uniform cross-section, and weighing 14.4521 grams at 0° centigrade. This unit was so defined by the Electrical Congress held in Chicago in 1893. Potential difference has been given some consideration in previous

chapters. The unit of potential difference is the volt. The magnitude of these units has been so chosen that when a current of one ampere is flowing through a conductor of one ohm resistance the potential difference between the ends of the conductor is one volt. The above statement is known as Ohm's law, and is given in terms of the practical units now employed. Ohm's law may be stated in the form of an equation: I (the current in amperes) =

E (the difference of potential in volts)

R (the resistance in ohms)

The above considerations lead to a new conception of potential difference and to very practical definitions of voltage, resistance and amperage. Studying Fig. 12 we can understand that the difference of pressure between the intake and the outlet of the pump is the same whether we take the pipe line into consideration or only the pump. The electrical circuit of Fig. 11 presents a similar case. The greatest potential difference between two points in this circuit occurs between the negative and positive poles of the battery. There is a rise of potential through the battery from N to P and an equal fall of potential from P to N through the turbine. The latter is often termed an R-I drop of potential. Transposing the Ohm's law equation we have a statement of the above facts in terms of the standard units.

$$E = RI$$

This form of the equation states that the voltage (E) between any two points in the electrical circuit is equal to the product of the resistance (R) in ohms and the rate of flow in amperes. In the circuit shown in Fig. 11 the resistance is not varied between any two points, and therefore if I changes E also must change. In other words, a current flowing through a resistance is equivalent to a voltage and is equal to the applied voltage.

Some Light Alloys

Professor Read and Mr. Greaves, of University College, Cardiff, have extended their study of the alloys of copper, nickel, and aluminum so as to include the light alloys of those metals. Their results are embodied in a paper entitled "The Properties of Some Nickel-Aluminum and Copper-

Nickel-Aluminum Alloys." In a preliminary series of experiments small trial ingots, weighing about 100 grammes, and containing varying amounts of aluminum, copper, and nickel, were cast in open chill moulds. From these ingots pieces were taken for cold rolling, wire drawing, and hot forging tests. In both hot and cold tests the effect of copper in reducing the malleability of aluminum was more marked than that of nickel. The authors were thus led to extend the range of composition of the alloys chosen for more detailed investigation to a higher percentage of copper and nickel than they otherwise would have done, and although their expectations with regard to the excellent behavior of the alloys on rolling were fully confirmed, the mechanical properties of the material are not well maintained in the higher members of the series. A number of ingots were then made and subjected to the following processes and tests: rolling, wire drawing, machining, tensile tests, calculation of specific tenacity (or the ultimate stress in tons per square inch divided by the weight of one cubic inch in pounds), effect of casting temperature, effect of additional work, elastic properties, alternating stress tests, hardness tests, specific gravities, melting points, electrical conductivity, corrosion tests, microscopic examination. The following concluding paragraphs of the paper may be noted:

The simplicity of the microstructure of the copper-nickel-aluminum alloys is reflected in practically all their properties. The authors have had occasion several times to point out that certain characteristics of the alloys are determined by the total percentage of copper and nickel present. This may very well be due to the fact that copper and nickel possess almost identical densities and very similar atomic volumes, and that the internal structure of the alloy remains practically unchanged by the substitution of one constituent for the other.

As regards both the heavy and light alloys of aluminum, copper and nickel, the authors have now completed a general survey, which should be of value in limiting the field of inquiry in the search for alloys of practical utility. They hope in the near future to investigate the properties of some of the more promising members of both classes of these alloys in further detail.

ETCHING REAGENTS AND THEIR APPLICATIONS

BY O. F. HUDSON, M.Sc., A.R.C.Sc.*

THE examination with the microscope of suitably prepared specimens has become one of the most profitable methods of investigation in studying the properties of metals and alloys, and is also a valuable means of controlling the manufacture of metallic articles and of testing the finished products.

The preparation of the specimen is carried out in the following stages:

- (a) Selection and removal of a piece of the material of suitable size and shape.
- (b) Filing or grinding a perfectly flat surface which is to be examined by the microscope.
- (c) Polishing the selected surface, usually by fine grinding on emery papers of increasing degrees of fineness, followed by wet polishing with a special polishing powder such as rouge, alumina, etc.
- (d) Treatment of the polished surface in order to reveal clearly the internal structure of the metal when the specimen is examined by the microscope.

The present paper is particularly concerned with the final stage in the preparation of the specimen, although the effects of the previous operations cannot always be ignored. A number of well-known metallographists were good enough to place their experiences of this subject at the author's disposal, but the present abnormal conditions have made it impossible to obtain or expect the co-operation of a great many workers of repute.

Commonly the methods employed to reveal the structure on the polished surfaces of metallographic specimens make use of the selective action of suitable solvents, and hence the term "etching reagents." Even in the case of a perfectly pure metal or an alloy consisting of a single uniform constituent, a solvent will not attack the surface uniformly, but will dissolve the crystals at different rates, so that after the attack there will be slight differences in level in passing from one crystal to another, the boundaries of the

crystals showing up as black lines when the specimen is examined under vertical illumination. The appearance of the crystal boundaries as black lines may also be due in part to the more rapid solution of the metal immediately at the boundaries of the crystals, thus giving rise to a very narrow channel separating adjacent crystals. When an alloy consists of two or more constituents their outlines will be revealed for similar reasons, and if the method is a simple etching the constituents will be distin-

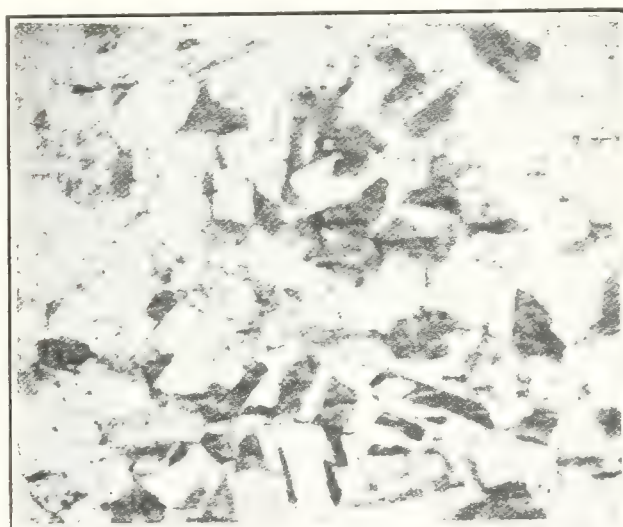


Fig. 1—Constantan Resistance Wire, Electro-etched, Magnified 150 diameters

guished by differences in appearance (*e.g.*, color) or arrangement. Generally speaking, the attack of the etching reagent also produces more or less pronounced roughening of the surface of each crystal and staining due to a film of oxide. In a single constituent material this surface staining serves to distinguish each crystal by differences of tint or depth of color produced, while in an alloy of two or more constituents certain constituents are stained (darkened), while others are unaffected or stained to a markedly different extent. Most metallographists freely make use of such staining as a means of identifying the constituents. The author, however, prefers in a critical examination of any alloy of two or more constituents to avoid, although this is not always possible, any staining and to identify a constituent by

*A paper read before the Institute of Metals.

some intrinsic property, such as a characteristic color, making use of staining only to confirm previous deductions, or to give contrast for demonstration purposes or for photography. For these reasons the author considers that the method of polish attack is most valuable, whether (a) in the form of a true polish attack such as was used by Osmond, or (b) in the form of alternations of very light etching and very gentle polishing.

The results of the etching process may be affected by the condition of the polished surface before etching. Thus it is necessary very briefly to refer to some of the effects of polishing. The mechanism of polishing has been studied by Beilby, whose explanation has been generally accepted, and whose work is well known. A lucid review of our present knowledge of the subject of polishing is given by Rosenhain in his recently published textbook,[†] and in a paper read at the Birmingham meeting of the British Association (Section B) in 1913, entitled "Metals, Crystalline and Amorphous." The production of a perfectly polished surface is the result of an alteration of the surface layers of the metal from the crystalline to a viscous amorphous form. This viscous surface layer becomes spread over the surface of the metal, filling up irregularities, such as holes or scratches, and spreads uniformly under the action of surface tension, giving a surface of a perfect polish. The smooth amorphous layer of metal which constitutes the polished surface is rapidly dissolved by etching agents and the crystalline material beneath exposed. As, however, scratches are not all removed by final polishing, but only covered up by the amorphous layer, the attack of the etching agent may cause the scratches to reappear. It is thus in a number of cases extremely difficult to get a satisfactory etching result. In other cases the presence of an amorphous film is not troublesome in practice. The greater part of the metal converted into an amorphous condition by polishing is reabsorbed at once by the crystalline metal, so that, although true polishing in all cases is the result of disturbance of the surface molecules, the surface after polishing is not necessarily covered by any

considerable film of metal in a vitreous amorphous condition. Not uncommonly constituents may be recognized on the untreated polished surface and more or less sharply defined from one another. It is probable that the amorphous metal, mobile only at the moment of polishing, does not spread far, and that the vitreous layer is not of uniform composition.

The difficulty of obtaining a surface suitable for etching is generally greater the softer the alloy. In most cases the use of ordinary metal polish for the last stages of polishing will give a surface that is good enough for all practical purposes. The metal polish may be used on chamois leather, or a little may be rubbed lightly on the specimen with the end of the finger, this being the better method for the final stage of the polishing.

As an example of the modifications of usual methods which may be found necessary in special cases the following account, contributed by A. G. C. Gwyer, of the polishing of aluminum and its softer alloys may be given:

"The chief difficulty attendant upon the polishing of pure aluminum and its softer alloys is the trouble which is experienced with the retention in the polished surface of the metal of the emery from the finer grades of polishing papers, as it is practically impossible to remove it subsequently on the wet polishing wheel. Professor Carpenter has obtained good results by the substitution of ordinary blotting-paper in the place of the final emery-paper, but the writer has never been able to achieve success with this method, and has, in fact, now abandoned dry polishing entirely. With the softest aluminum the writer has obtained excellent results following the procedure here given:

"(a) Fine file, kept thoroughly wet with paraffin oil.

"(b) No. 1 emery-paper, soaked in paraffin, on wooden board.

"(c) No. 2 emery-paper, soaked in paraffin, on wooden board.

"(d) Diamantine powder on cloth-covered polishing wheel, kept thoroughly moist with water and also maintaining the supply of polishing powder.

"(e) 'Globe metal polish' on 'Selvyt' cloth, on polishing board, rubbing lightly. It may be found on examination that there has been some appreciable surface flow, in

[†]"An Introduction to the Study of Physical Metallurgy."

which case it is necessary to revert to No. 2, or possibly even No. 1, emery-paper and repeat all the above operations. This does not, however, usually take very long to carry out, and only very light pressure with the hand is required. The final polish before etching for micrographic purposes should be effected with a little metal polish on the finger, rubbing very lightly."

The etching reagents which are used to develop the structure of metals and alloys include the mineral acids and certain organic acids, ammonia and other alkalies, and solutions of certain salts. They are usually more or less diluted with water or other solvent, and the etching effects can be varied and controlled by altering the concentration of the solution or by using different solvents. The influence of the solvent on the power of the etching agent is dealt with by Robin in his "Traité de Métallographie." A reagent is more rapid in its attack when the degree of ionization is increased. There is a relation between the ionizing power of the solvent, influenced by viscosity and other factors, and the speed of attack of the reagent. Picric acid, for example, in solution in liquids of high viscosity (*e.g.*, amyl alcohol, glycerine) has a slow, though very clear, etching effect. A very slow rate of etching, however, is usually inconvenient, and water and ethyl alcohol are the most generally used solvents.

Before the specimen is immersed in the etching solution, care should be taken to observe that the surface is perfectly clean and free from any trace of grease. It is most important that the etching solution should immediately come in contact with every part of the surface, as otherwise uneven and possibly misleading effects may be obtained. Washing with a dilute solution of caustic soda or caustic potash, or with ether, will ensure the removal of all grease.

The treatment of the specimen after it has been acted upon by the etching reagent is also a detail to which attention must be paid. When the etching has proceeded to the desired extent, the specimen is at once washed thoroughly in order to remove all trace of the etching reagent. Usually it is simply rinsed with water, but frequently the washing is done with absolute alcohol, while ether and chloroform are also sometimes used. As soon as the washing is

finished, the specimen should be dried quickly to prevent any undesired staining or tarnishing. Generally an old handkerchief may be safely used for this purpose, but if alcohol or other volatile liquid has been used for washing, the specimen may be dried naturally in air or by allowing a current of air, which may be warmed, to play upon the surface. This latter method is especially desirable where it is required to retain some surface deposit liberated by the etching reagent, as, for example, carbon liberated from steel.

In the following account of individual etching reagents, those suitable for non-ferrous metals and alloys are first described, and afterwards a brief account is given of the principal reagents used for iron and steel. There are also included separate short sections devoted to electrolytic etching, "polish attack" and "heat tinting."

Etching Reagents for the Non-ferrous Metals and Alloys

Ammonia.—A dilute aqueous solution is used for copper, brass, and other alloys rich in copper. Simple immersion for a short time in strong ammonia (0.880) diluted with about its own bulk of water generally serves to develop the structure. The copper is oxidized and dissolved in the ammonia, leaving the crystals stained and colored to different degrees in the case of pure copper and alloys consisting of only one constituent. With alloys consisting of two or more constituents, certain constituents are darkened in preference to others, and so may be distinguished. Ammonia used in this way has the disadvantage that the staining is not always under control; it may be excessive and misleading. The etching power of ammonia is increased by the addition of a little hydrogen peroxide, although the results obtained are not always improved. Desch recommends rubbing the ammonia on the specimen. He states that for brasses generally he uses "dilute ammonia rubbed on lightly and evenly with the tip of the finger or a small plug of cotton wool, renewing the liquid occasionally. This develops the structure better than any method I know, and does not produce great differences of level. Some special brasses will not develop clearly with ammonia, and need ferric chloride." Sauveur uses bromine water (*q.v.*) in conjunction with ammonia. The author finds ammonia suitable for cop-

per and its alloys, particularly brasses. The method employed is to rub the specimen with ammonia on parchment. The parchment is *thoroughly* moistened with water, and then spread on a smooth wooden support. Three or four drops of dilute ammonia (one part strong ammonia to one part water) are sprinkled on the parchment, together with a little freshly ignited magnesia, made from carefully prepared and thoroughly washed magnesium carbonate. The specimen is then rubbed gently but steadily, usually with a circular motion, on the parchment for a short time—say fifteen seconds—washed thoroughly, dried quickly on old clean linen, and examined. If necessary, the operation is repeated. This method is a true polish attack, and, by suitably varying the amounts of ammonia and magnesia and the strength of the rubbing, the crystals may be darkened to different degrees, or the constituents may be seen quite unstained and clearly outlined. For many copper alloys the author prefers this method, even to the use of ammonium persulphate, but it must be admitted that a little practice and experience are required to obtain uniformly satisfactory results. L. Archbutt generally etches copper by rubbing with ammonia on parchment, but finds that the results are uncertain. "Sometimes the structure comes up quickly and quite well, but other times the specimen stains badly, and has to be repolished and re-etched." He does not find the result much better when a drop of hydrogen peroxide is added to the ammonia in etching on parchment. Also, immersion of the specimen in ammonia and hydrogen peroxide, or in ammonia and ammonium persulphate, has not been found to give any better results. With regard to alloys, he finds that 70 : 30 brass etches very well with ammonia on parchment, but sometimes better results have been obtained by immersing the specimen in ammonia and hydrogen peroxide. He has found that "Muntz metal was very nicely etched on the polishing wheel, using diamantine on cloth moistened with dilute ammonia (1 : 4)."

Ammonium Persulphate is one of the most useful etching agents for copper alloys, and was first suggested by E. F. Law, from whose book on "Alloys" the following is taken, "on account of two useful properties which it possesses. Firstly, the etching is effected by simple immersion of the specimen, no rubbing being required, as in the

case of some other etching agents. This is an important consideration with soft alloys, which are very easily scratched by rubbing. Secondly, the action takes place without formation of gas bubbles, which are always liable to adhere to the polished surface and cause uneven etching. One precaution, however, must be observed in the use of ammonium persulphate—the polished surface must be absolutely free from oil or grease." The following details of his method of using this reagent are taken from a previous paper: "In the case of the majority of copper alloys, the best etching agent is a 10 per cent. aqueous solution of ammonium persulphate. . . . The only precaution to be observed is that the surface of the specimen should be free from any trace of grease, this being easily secured by the application of a solution of potash or soda immediately before immersion in the persulphate." Desch finds the ammonium persulphate is "useful for deep etching of brasses when it is desired to bring out the separation into crystal grains."

Aqua Regia is used for gold and platinum and their alloys. Sir Thomas K. Rose has supplied the following details of the method he employs: "The reagent is made up of nitric acid one part, hydrochloric acid five parts, distilled water six parts. Use at about 15 deg. C. The etching is slow, and its progress can be watched. Pure gold is etched sufficiently for oblique illumination in about one hour. This works well with cast gold, or hammered or rolled metal, and also annealed specimens, without preparation except removal of grease. With polished specimens the results are less certain, but are more uniformly good than with stronger or hotter acids. With this strength and temperature the presence of gold chloride in the acid appears to have no influence on the result. Alloys of gold and silver, gold and copper, etc., containing over 90 per cent. of gold, are equally amenable to this reagent."

Bromine Water.—Sauveur uses this reagent for copper and certain of its alloys rich in copper. "The specimens are first etched in bromine water, and this is followed by a wash in ammonia, the surface of the specimen being rubbed gently with the finger while in the ammonia bath."

Chromic Acid is used by Gulliver for alloys of copper. He "generally uses a saturated, or nearly saturated, solution, and

finds it often better than ferric chloride or alkaline copper ammonium chloride. It is specially useful for copper-zinc alloys." He considers it the most useful etching agent he has discovered.

For zinc, Desch recommends Tinoféef's reagent (94 grammes HNO_3 + 6 grammes CrO_3): a few drops of this to fifty cubic centimeters of water.

Cupric Ammonium Chloride was introduced by Heyn, and is used for steels and for copper and its alloys. The solution is made by adding ammonia to a solution of five grammes of cupric chloride in 100 cubic

chloric acid for many of the copper alloys—bronzes, aluminum-copper alloys, German silver, phosphor bronzes, etc.—but not often for brasses. No rule is followed in making up the solution, but generally a few drops of strong hydrochloric acid are added to about five cubic centimeters of a strong (syrupy) solution of ferric chloride and water added to give an orange-colored solution. Desch recommends ferric chloride for bronzes and aluminum-copper alloys. He generally uses concentrated hydrochloric acid to which a few drops of a stock laboratory solution of ferric chloride have been added, but it is sometimes necessary to dilute slightly with water. He finds the best composition in each instance by trial. He also notes that "ferric chloride has an astonishing power of revealing latent scratches," a characteristic that was also observed by Heycock and Neville. This disadvantage, however, is shared by most etching agents in a greater or less degree.

At the National Physical Laboratory (Rosenhain) an acid solution of ferric chloride is most frequently employed for all ordinary copper alloys in which it is desired to reveal the general structure, the exact composition being:

FeCl_3	10 grammes
HCl	30 cubic centimeters
Water	120 cubic centimeters

"This reagent brings out a structural pattern on nearly all copper alloys, but it is most satisfactory for pure copper, zinc-copper, and aluminum-copper, and their ternary derivations. Some alloys, however, such as nickel-copper, are only slowly attacked by this reagent, and no very satisfactory results are obtained with these. For such resistant alloys, electrolytic etching is found very useful."

L. Archbutt uses the following mixture for bronzes:

HCl (specific gravity 1.1) ..	20 cubic centimeters
$\text{FeCl}_3 \cdot 7\text{H}_2\text{O}$	1 gramme
Water to	100 cubic centimeters

and finds that "this reagent brings up the structure very well, but accentuates every scratch on the specimen."

Hoyt uses "a solution of 3.26 grammes FeCl_3 and 24.5 cubic centimeters HCl (1.12) in 1,000 cubic centimeters water, as recommended by Heycock and Neville, to etch the copper-tin alloys and other alloys of copper." For brasses, bronzes, aluminum bronzes, etc., he uses either ferric chloride

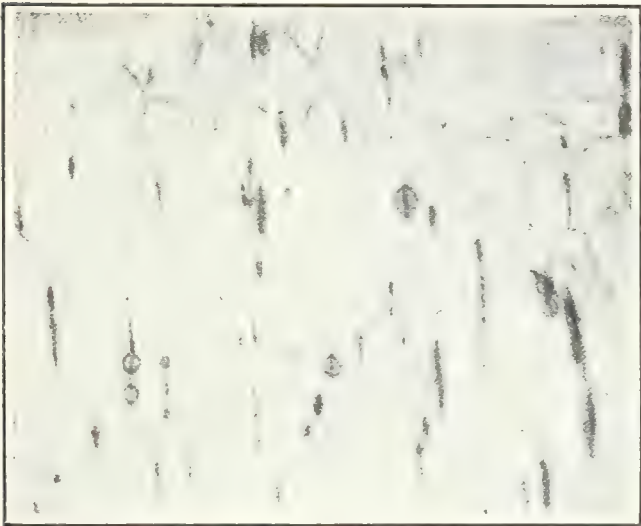


Fig. 2—Monel Metal, Electro-etched Longitudinal Section from Bar Magnified 150 Diameters

centimeters of water until the precipitate is dissolved. Desch writes that: "For copper, the best deep etching is got from ammoniacal copper ammonium chloride prepared according to Heyn's directions." Hoyt uses a basic solution of copper ammonium chloride for etching copper and its alloys. Ten grammes of copper ammonium chloride are dissolved in 120 cubic centimeters of water, and the solution is treated with ammonia until the precipitate which forms just goes into solution, giving a clear blue color.

Ferric Chloride, introduced by Heycock and Neville for etching copper-tin alloys, is very widely used for copper alloys generally. The strength of the solution and the amount of hydrochloric acid present vary considerably, and what is considered the most suitable composition for any class of alloys is commonly found by trial. Although as a rule preferring other reagents, the author also uses ferric chloride and hydro-

or alkaline cupric-ammonium chloride, in some cases one and in some cases the other being the more suitable. Thus, "in the ternary alloys of copper-tin-zinc, while both reagents may be used, the acid ferric chloride gives a better defined structure for the tin-rich alloys, while the basic copper-ammonium chloride produces better results if the zinc is in excess. Again, these two etching reagents give reciprocal effects on the copper-aluminum alloys. The copper-ammonium chloride attacks the constituents of these according to their copper content, while the ferric chloride attacks the constituents in the reverse order, according to their aluminum content. In doubtful cases one etching reagent serves as a check on the other."

Gwyer finds acid ferric chloride useful for aluminum-nickel, aluminum-cobalt and copper-rich aluminum-copper alloys. Gulliver uses acidified ferric chloride for alloys rich in antimony, bismuth or tin.

Hydrochloric Acid is used for white metals containing high percentages of tin. Either the concentrated or dilute acid may be used. In the former case the specimen is dipped in the acid for a few seconds, and, when sufficiently etched, washed thoroughly and dried quickly on a soft rag. When the dilute acid is used for rich tin alloys, the concentration of the acid may be varied according to the composition of the alloy. Gwyer finds that hydrochloric acid is suitable for the iron-rich aluminum-iron and the tin-rich aluminum-tin alloys. He states that the exact strength is best found by trial, and should be so regulated that the evolution of gas bubbles is fairly brisk, a comparatively short time of immersion appearing to answer the best.

Hydrofluoric Acid was introduced by Brislée for etching aluminum. One part of fuming hydrofluoric acid is added to ten to twenty parts of water. After treatment in this solution the specimen should be cleared by dipping it for a few seconds in strong nitric acid and then washed and dried. Gwyer finds this method "most valuable on account of the beautiful manner in which it develops the structure of pure aluminum—cast, worked, or annealed." Rosenhain uses this reagent for aluminum and its alloys, and finds that a solution of hydrofluoric acid (one to eight), followed by immersion in dilute nitric acid (60 per cent.), is very satisfactory, particularly for revealing the

crystalline structure of pure aluminum and of homogeneous solid solutions.

Nitric Acid is used sometimes for etching copper alloys, and is found useful for the rapid etching of 70 : 30 brass for commercial purposes when crystal size is to be judged. Probably the best way to use it for this purpose is to dip the specimen momentarily in strong acid and wash at once under the tap. Gwyer also finds that the concentrated acid gives excellent results with the copper-rich aluminum-copper alloys.

Rosenhain states that "both for copper and zinc-copper very brief etching with nitric acid gives useful indications. While the general structure is revealed, there is also a vigorous pitting action which occurs wherever undissolved foreign matter is present, such as specks of oxide or, more particularly, of lead in brass. Such enclosures are very minute before etching, and are developed into prominent black patches by the action of nitric acid." Rosenhain also uses this reagent for pure lead, which "is satisfactorily etched by prolonged immersion in dilute nitric acid in water (5 per cent. to 10 per cent.). If the etched surface is dull, it can be brightened by laying the specimen in water with the etched surface just immersed and pouring on a small quantity of strong nitric acid. This at first produces a deep tarnish, which is rapidly removed by agitating the water. Nitric acid is also useful in etching alloys of lead and tin, and such alloys as type metals and bearing metals."

Nitric acid of 1.2 specific gravity is used by L. Archbutt for white metals, the structure usually being developed well in ten seconds.

Iodine is found by Gulliver to be most suitable for alloys rich in zinc or cadmium. He uses a solution of one part iodine, three parts potassium iodide, in ten parts of water.

Caustic potash and caustic soda are used for zinc and aluminum and alloys rich in these metals. At the National Physical Laboratory "caustic soda is found satisfactory for etching the alloys of aluminum with zinc, copper, manganese, etc. This reagent, however, often leaves a black deposit on the etched surface. This can be very satisfactorily removed by dipping the specimen in a solution of chromic acid in water." Concerning the use of caustic soda, Gwyer writes that "this reagent, in strengths vary-

ing from 5 per cent. to 20 per cent., is the most generally employed for aluminum and aluminum-rich alloys. It usually gives good results, provided that the specimen is not immersed too long, when pitting will ensue, and the black deposit liberated by its action is instantly removed by dipping the specimen, after rinsing off excess soda in running water, in concentrated chromic acid—a method originated by S. L. Archbutt of the National Physical Laboratory.”

Silver Nitrate.—A 5 per cent. solution in water may be used for alloys of lead, tin, antimony, and bismuth. The black deposit left on the surface is washed off.

Etching Reagents for Iron and Steel

The number of reagents which are used or have been proposed for etching iron and steel is very large, and it is only intended to deal with the more important of them here. Many of the reagents are used to identify some particular constituent of steels, or in the examination of steels which have received some special treatment. Details concerning such reagents, and further information on those dealt with in this section, may be sought in the pages of the *Journal of the Iron and Steel Institute*.

Copper Ammonium Chloride.—This reagent, introduced by Heyn, usually consists of a 10 per cent. solution of the salt in water, and is suitable for wrought iron and mild steel. The specimen is immersed in the solution for about one minute, then washed, and the copper deposit, which is readily detached, wiped off under running water. This reagent is used for deep etching effects, and also to darken parts rich in phosphorus. Howe uses this reagent (one part of the double salt to twelve parts of water) for low carbon iron and steel. He finds that it “shows grain boundaries readily, but rather obscures Neumann lines,” and that it is the best reagent for etching figures and pits. Hoyt uses a similar solution “principally for microscopic examination of low carbon steel, wrought iron, white cast iron, and in the determination of phosphor segregations in wrought iron.”

Copper Chloride.—Dilute acidulated copper chloride in alcohol is used by Stead to detect phosphorus in steels. The reagent is made up as follows:

Copper chloride	10 grammes
Magnesium chloride	40 grammes
Hydrochloric acid	20 cubic centimeters

The salts are dissolved in the least possible quantity of water, and the solution made up to 1,000 cubic centimeters with alcohol. The purer portions of the steel become coated with copper before the phosphoric portions.

Hydrochloric Acid.—A dilute solution (1 per cent.) in ethyl alcohol is generally used. Hoyt writes that a solution of one cubic centimeter hydrochloric acid (specific gravity 1.19) in 100 cubic centimeters absolute alcohol “is recommended for all the iron-carbon alloys whether in a hardened or annealed state,” while the action can be accelerated (for special steels) by the addition of a few cubic centimeters of a 5 per cent. solution of picric acid in alcohol. Howe uses a solution of five cubic centimeters of concentrated hydrochloric acid in ninety-five cubic centimeters of ethyl alcohol.

Iodine.—The use of iodine was suggested by Osmond, who used the ordinary tincture, and this is the form in which it should be used. A simple solution in absolute alcohol is not so suitable. The specimen may be immersed in the solution, or a drop or two placed on the surface to be etched, and allowed to remain until decolorized.

Nitric Acid.—Until the introduction of picric acid a dilute solution of nitric acid was the principal etching agent for iron and steel, and it is still very often used. It was used by Sorby, Roberts-Austen, Osmond, and most of the earlier investigators; Arnold, Howe, Sauveur and others use it, and many still consider it to be the best general etching agent for iron and steel. Solutions (up to about 5 per cent.) in water, or, preferably, alcohol, are generally used. When alcohol is the solvent, absolute alcohol should be used for washing the specimen, and not water. Lantsberry, who always uses nitric acid for steels, points out that the success of the method depends on thoroughly washing the specimen with alcohol and drying at once, and that the surface should never be moistened with water.

Sauveur writes that for all grades of steel, wrought iron, and pig iron, regardless of treatment, he uses solutions of concentrated nitric acid in absolute alcohol in proportions varying between 1 per cent. and 10 per cent. of acid, according to requirements. He prefers it to picric acid. The samples are washed in absolute alcohol and dried by means of an air-blast. For manganese steel he uses 10 per cent. nitric acid

in absolute alcohol, leaving the specimen in the bath until it is covered with a black deposit. It is then washed in alcohol, without any attempt at removing the deposit by rubbing.

Howe uses a solution of 2 per cent. of concentrated nitric acid in water for hardened steels, manganese steels, etc., and also occasionally to develop grain boundaries quickly in low carbon material, although he notes that it roughens up the ferrite much more than picric acid. He recommends a preliminary treatment for the removal of grease, using "alcohol, hydrochloric acid in alcohol, or, best picric acid in alcohol."

Hoyt remarks that "nitric acid is particularly serviceable for determining the grain size of known steel and the final temperature at which it has been worked but for micrographic analysis is a dangerous reagent.

A 4 per cent. solution of nitric acid in isoamyl alcohol (as suggested by Kourbatoff) is also used, and gives a slow and delicate etching. Hoyt uses this for "quenched steels, tempered steels, and to examine the structure of nickel steels," and Desch states that he mostly uses this solution for hardened steels.

Picric Acid.—This reagent, introduced by Ischewsky, is the one most commonly used, generally as a saturated, or nearly saturated, solution in alcohol. The specimen is immersed for times varying with the kind of steel and the effect desired, from a few seconds for light etching of ordinary rolled or annealed steels and cast irons, to several minutes for hardened steels and wrought irons. Picric acid is sometimes used in conjunction with nitric acid. Thus Desch recommends for all ordinary (unhardened) steels alcoholic picric acid to which a few drops of nitric acid have been added. A solution of picric acid in amyl alcohol is also used for slow etching. L. Archbutt also finds it "an advantage to add a small quantity of nitric acid, which gives greater certainty of etching, especially in cold weather." The solution he uses contains eighty volumes of picric acid in alcohol and twenty volumes of 2 per cent. nitric acid in alcohol.

Rosenhain's and Haughton's reagent consists of—

Ferric chloride	30	grammes
Hydrochloric acid (conc.)	100	cubic centimetres
Cupric chloride	10	grammes
Stannous chloride	0.5	grammes
Water	1,000	cubic centimetres

It is used for determination of the distribution of phosphorus in steel, the purer portions of the steel being stained by deposition of copper, leaving the phosphorus-rich portions white.

Of the numerous other reagents some are used for special purposes, such as sodium picrate, for the detection of cementite; while others are more or less complicated solutions, such as Kourbatoff's reagent, consisting of three volumes of a saturated solution of 0-nitrophenol in alcohol and one volume of a 4 per cent. solution of nitric acid in alcohol, used for the determination of troostite and sorbite in hardened steels.

Electrolytic Etching

This method is of great value in special cases. Generally a solution of a neutral salt is used as the electrolyte; the specimen is made the anode and a piece of platinum foil the cathode. A feeble current of a small fraction of an ampère is used.

Desch finds that etched figures in brasses, etc., are most perfectly developed by electrolytic etching, using a 5 per cent. sodium chloride solution and a platinum cathode with two dry cells.

Other electrolytes used are ammonium nitrate, sodium thiosulphate (used by Le Chatelier for copper-tin alloys), ammonia, and sometimes very dilute acid solutions.

For Monel metal, L. Archbutt "obtained very good results by electrolytic etching in a solution containing forty-five cubic centimeters dilute sulphuric acid (1:3) and five cubic centimeters hydrogen peroxide solution, using a current of 0.1 ampère and 0.5 volt, etching for about fifty seconds. A slight staining of the specimen was subsequently removed by light rubbing with a dilute solution of bromine in hydrochloric acid." Constantan was etched in a similar way, "but stains were removed by using a mixture of dilute sulphuric acid and hydrogen peroxide and rubbing with the finger." Two photographs supplied by Mr. Archbutt, and reproduced on Plate I, illustrate the value of this method.

Rosenhain has also found that electrolytic etching is useful for nickel-copper alloys.

Polish Attack

Mention has been made of this method, which was used with such success by Osmond, in an earlier part of the paper, and

it is one which, if not always applicable, the author believes is not adopted as widely as it should be.

The objections which appear to be urged against the method are (a) the difficulty of getting uniformly good results, and (b) the danger of obscuring the structure by the flowing action of polishing. Neither of these objections need, however, be serious; the former is overcome by experience, while the latter is probably largely imaginary, unless altogether unnecessary pressure is used. The procedure which has been found suitable for copper and its alloys has already been described in dealing with ammonia as an etching agent. For steels, Osmond used a very gentle etching reagent, such as a 2 per cent. solution of ammonium nitrate with precipitated calcium sulphate in parchment, but this method is not now so often used. The author, however, for iron and steel, makes use of parchment thoroughly soaked in water on which a paste of precipitated calcium sulphate is spread. The specimen is then alternately lightly etched with picric acid, and rubbed gently for a few seconds on the parchment. Frequently also it is found to be of advantage to etch the specimen lightly, then polish very gently with alumina and re-etch, repeating if necessary.

Gwyer finds that polish attack is sometimes very effective for light aluminium alloys, "for example, in bringing out the structure of the iron-aluminium eutectic. For this, washed and ignited magnesia is required, the polishing being done on parchment kept moistened with very dilute caustic soda solution."

Gulliver notes that sometimes a good polish attack may be obtained with water alone, although not if the pad is new. He found, for example, that polish attack with water alone was effective in the case of bismuth-tin alloys.

Heat Tinting

Although not perhaps, strictly speaking, an etching process, heat-tinting is a valuable and widely used method of revealing the structure of alloys, and especially for the detection of small differences in concentration of solid solutions. The process was introduced by Stead many years ago, and has been considerably developed by him since. It consists in heating the specimen until a thin film of oxide is formed

on the surface, differences in composition giving rise to variations in thickness, and hence variations in color of the film. He used it with great advantage in studying phosphoric cast irons and alloys of iron and phosphorus, and showed that by its use phosphide and carbide of iron could readily be distinguished, while Heycock and Neville proved its value in their work on the copper-tin alloys. Stead has also applied the method to the determination of the distribution of phosphorus in steel. In a paper on "Metallographic Methods for the Detection of Phosphorus in Steel," read before the Cleveland Society of Engineers in December last, Stead gives details of the heat-tinting method suitable for this purpose. The specimen is floated on a bath of molten tin at a temperature of about 300 degrees C., and allowed to remain until the whole surface has a reddish-brown color. On examining the specimen, the portions richest in phosphorus will be detected by their blue color, since the parts which are richer in phosphorus than the surrounding metal become colored more quickly. The preliminary treatment of the specimen before it is raised to the tinting temperature is important. Washing with a 1 per cent solution of picric acid in alcohol is recommended, and the surface should always be "cleaned by rubbing with a clean piece of linen or cotton. The specimen is heated to about 150 degrees C., and then rubbed with a clean piece of chamois leather while still hot." It is then immediately raised to the tinting temperature.

Instead of heating in air and obtaining a colored oxide film, Stead has shown that other atmospheres may be used, such as sulphuretted hydrogen or bromine. The use of an atmosphere containing bromine for the examination of Muntz metal has been described recently by Stead in the Journal of the Institute of Metals.

Heat-tinting appears to require considerable experience in order to obtain consistent results, and the author, among others, cannot rely upon it to be uniformly successful.

In conclusion, the author gives a summary of the principal reagents for particular metals and alloys, as described in detail elsewhere in the paper.

The following list is an excellent summary of the most suitable etching reagents, and good results may be obtained by their use if careful attention is given to the prepara-

tion of the surfaces, as pointed out earlier in this paper:

Etching Reagents Suitable for Particular Metals and Alloys

Copper

Ammonia, ammonium persulphate, bromine (with ammonia), copper-ammonium chloride.

Brasses

Ammonia, ammonium persulphate, copper-ammonium chloride, electrolytic etching, ferric chloride, chromic acid, nitric acid.

Bronzes

Ammonia, ammonium persulphate, ferric chloride.

Copper-Aluminium Alloys (Aluminium Bronzes)

Ammonium persulphate, ferric chloride, copper-ammonium chloride, nitric acid.

German Silver

Ammonium persulphate, ferric chloride.

Nickel-Copper Alloys, Monel Metal, etc.

Electrolytic etching.

Gold and Rich Gold Alloys, Platinum and Its Alloys.

Aqua regia (dilute).

Aluminium and Light Aluminium Alloys.

Caustic soda, hydrochloric acid, hydrofluoric acid.

Lead, Tin and Their Alloys (White Metal, etc.)

Chromic acid in nitric acid, ferric chloride, hydrochloric acid, nitric acid, silver nitrate.

Zinc and Alloys Rich in Zinc.

Caustic soda, iodine.

Iron and Steel

Reagents given in separate section.

As Others See Us

The publishers of the BRASS WORLD & PLATERS' GUIDE are continually receiving letters from subscribers expressing their appreciation of the value of the publication to them. It would be impossible to publish even a reasonable number of these on account of the lack of space, while on the other hand, many of our readers might not care to be quoted. However, we wish to assure our readers that letters of this kind are always appreciated to the fullest extent. As an indication of the "international" character of these letters, we have received in one day's mail, two letters, one from a brass founder and electroplater in Waverly, New South

Wales, and the other from a large brass foundry in England. The former states "the January issue of the BRASS WORLD to hand, for which I thank you. I am very much pleased with it and consider it quite the best value I have ever obtained for the price. I have shown it to one or two friends in the trade and I think they will become co-subscribers."

The English firm states: "We have been taking the BRASS WORLD for many years and we wish to say with pleasure that we have always found the information contained therein to be very beneficial to us in our business."

A subscriber writes us for information regarding the sudden and tremendous rise in the price of copper and brass. He states that his firm wants to give their customers some information regarding the whys and wherefores of these advances in brass and copper.

We have found it rather difficult to get any definite and accurate information regarding the sudden rise in the price of copper. No one seems to wish to go on record. There also seems to be wide differences of opinion among the usual authorities in matters of this kind as to the causes of the present situation.

We find that the refineries have 100,000,000 pounds less copper to treat this year than in 1913, and according to the table of copper imports given for the years 1912-13-14 there has been a steady and progressive decrease of ore and pig copper shipments since 1912, and this is especially noticeable in the case of Mexico, as was to be expected. From this country the shipments of pig copper have decreased 61,548,325 pounds from 1912 to 1914, and undoubtedly this condition has been accentuated during 1915 as far as we have gone. This falling off in imports, and the increased demand consequent upon the war has undoubtedly had a great deal to do with the price increase. And incidentally, we might mention that few people have any idea of the enormous amount of bronze and other alloys that is being put into the makeup of the auto trucks that are being furnished to the warring Europeans.

Don't throw the scrap from various departments into a bin, where it accumulates, when it is sold to some junk dealer at a low price. Classify and sell at a good price.

RECLAIMING BRASS SWEEPINGS*

A Recovery Process for Foundries, and the Equipment

BY A. W. LEMME†

Illustrations furnished by courtesy of "The Foundry"

It is to be borne in mind that this problem, so far as our company is concerned, is large and vital. With a melting capacity of about 100,000 lb. of metal per day, using two cars of coke a week, one car of fuel oil every 10 days, and about 80,000 lbs. of molding sand per month, our refuse accumulates to the extent of 12,000 to 15,000 lbs. a day. In accordance with the occupational disease act, we are not allowed to sweep any floors during working hours. Therefore, it

cheapest way is to dump the refuse in one pile in the back yard and pick out the largest pieces of metal by hand. We then put the rest through a large screen of 1-in. mesh, and that portion of the refuse which goes through the 1-in. mesh is put through a crushing process.

Apparatus and Process Used

The crusher we have installed, one purchased from the Thomas Carlin's Sons Com-



Fig. 1—The Refuse and Sweepings are First Picked Over and Screened by Hand, the Workman Wearing a Respirator for Protection Against Dust

is necessary that we perform this duty at night, and inasmuch as we sweep our foundry and clean the plant, in general, with unskilled labor, we have found that the

pany, Pittsburgh, Pa., is run by a 35-hp. motor and is washed by a water process. The two wheels of the crusher are about 4 ft. in diameter with a 10-in. face, weighing about 6,000 lbs. each, running in a pan 18 in. deep and about 10 ft. in diameter. The crusher is sunk in the floor, the top of the

*From a paper presented before the Chicago Foundrymen's Club, April 10.

†With the Chicago Bearing Metal Company, Chicago.

pan being on the floor level, making the feeding of the pan as easy as possible. We feed the pan some 30 min. steadily, then stop the crusher and shovel the heavy brass out of the pan into a jig consisting of a 14-in. square pan with a brass screen of 100 mesh in the bottom. The water agitates through the screen and through the brass. The brass is then shoveled out and the iron picked out by hand.

Many fine particles of brass escape with the overflow of water agitating through the jig screen, and this overflow, in conjunc-

used in our cupola direct, and the fourth, the concentrate, which runs about 20 per cent. metals, is briquetted by using 90 per cent. concentrate and 10 per cent. of the very cheapest stucco we can buy (about \$5 per ton, carload lots). We form our briquettes by using the above formula, adding enough water to make the mixture a soft mud and shoveling it into forms which set quickly. Two men at 20c. per hour make 300 briquettes per 10-hr. day.

In order to control the efficiency of the concentrating table we take a chemical

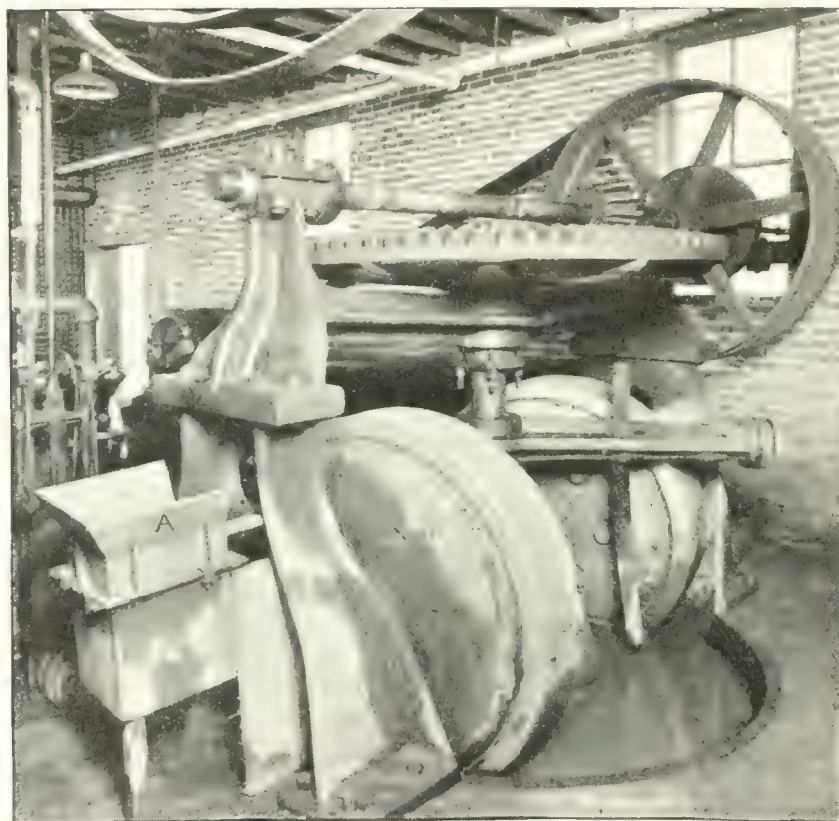


Fig. 2—Clay Mill in which Screened Refuse is Ground—At "A" is Box Containing 100-Mesh Screen through which Product of Mill is Sifted

tion with the overflow from the crusher pan, is led into a pit where a Frenner sand pump automatically conveys this product to an Overstrom concentrating table. The jig, sand pump and table are operated by a 5-hp. motor, belt driven. These processes render four separations of refuse, useable: 1. The large pieces of metal separated by hand. 2. The washings. 3. The pieces that are too large to go through the 1-in. mesh. 4. The concentrate recovered by the Overstrom table.

How the Separations Are Used

The first two separations are used directly in our foundry practice, the third is

analysis of our tailings, or the refuse after the concentrate has been separated. We find an average of 0.85 copper, representing 1.10 metal contents, and we analyze these tailings every 24-hr. run. The washings recovered by the above process we find by chemical analysis about 85 per cent. metal as follows: 77 per cent. copper, 12 per cent. lead, 7 per cent. tin and 4 per cent. zinc and impurities. Washings are also analyzed daily.

As I have stated, the third and fourth separations of the refuse are treated by cupola practice, the one used being a 24-in. water-jacket cupola. Measuring from the bottom to the tuyere holes, there is a straight wall

12 in. high and 24 in. in diameter, the slag hole being 6 in. above the metal hole. The cupola measures 10 ft. from tuyere holes to charging door and increases in diameter from 24 in. to 38 in. at the top. A 4-in. water jacket surrounds the cupola between these points. The only brick lining in the cupola is between the bottom and the tuyere holes. The blast is furnished by a 6-ft. Connellsville positive-pressure blower driven by a 7½-hp. motor. We have experimented with pressure from 8 to 16 oz. and we have found, in melting this low grade material,

metal would be carried off with it. The slag is tapped into regular slag buggies used by smelters in general and is set aside to solidify before emptying. After being emptied, each ball of slag is broken and inspected for metal, and we often find a good-sized nugget at the bottom. This shows, to our satisfaction, that the slag is thin enough to allow the metal to find its place by gravity.

A sample of the slag is taken by using a small babbitt ladle and pouring a small portion into cold water once every hour, and

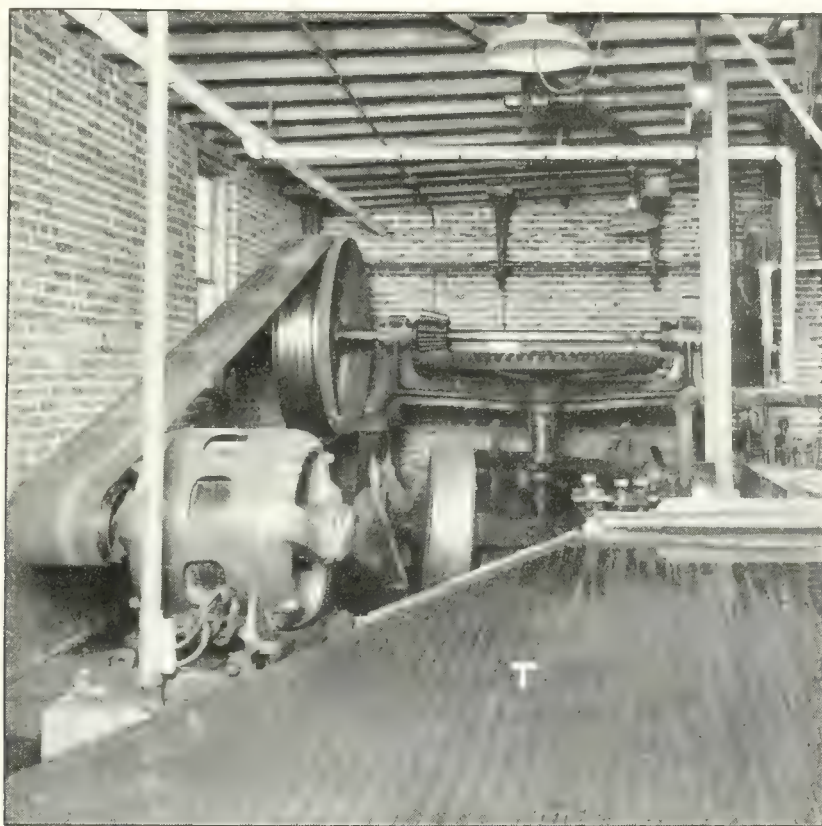


Fig. 3—Concentrating Table "T" with Grinding Mill in Background

that pressure from 12 to 14 oz. gives the best results, holding the water in the jacket at about 100 deg. F.

The charges are made as follows: 250 lb. limestone, 380 lb. refuse, 100 lb. slag direct from cupola, 100 lb. coke and 2 buckets of water. The capacity of the cupola is about five of the above charges per hour.

Characteristics of the Slag

The slag is tapped three times per hour and is held at a consistency of cream, not allowing it at any time to become sticky, as it is absolutely necessary to keep the slag thin enough for the metal to flow through it freely; otherwise a large portion of the

one analysis is taken on each 12 samples. We have found by this method that the sample is easily pulverized and dissolved. The average analysis is 0.97 copper, 43.50 silicon dioxide and 22.60 metallic iron. We generally make two taps of slag to one tap of metal, bringing down from 8 to 12 ingots weighing about 25 lb. each. One ingot is selected from each hour's run and a complete analysis is taken from the drillings of 12 ingots, thereby taking two complete analyses to each 24-hr. run. The average analysis is 82 per cent. copper, 8 per cent. tin, 7 per cent. lead and 2 per cent. zinc and impurities.

This little cupola has been run as long as

12 days and 13 nights without interruption. Great care must be taken in charging it, as the cupola is small and tapered and is easily hung.

These installations are a combination of ideas gathered through personal experience and the experience of other manufacturing plants which I had visited in the East and Middle West previous to installing machinery in our new plant. For instance, the crusher used is a clay-mixing machine, while the jig, sand pump and concentrating table are mining propositions. Not many brass

was more by good luck than great knowledge; and for a few years the brass foundry practically stood still.

But the coming of the chemical engineer with his laboratory and apparatus have made marked changes in the brass foundry practice lately.

The up-to-date brass foundryman is broad-minded and passes along the information he discovers. He has put the art of producing castings on a higher plane. There are still some foundrymen who resent the entry of the scientific man into the foundry,

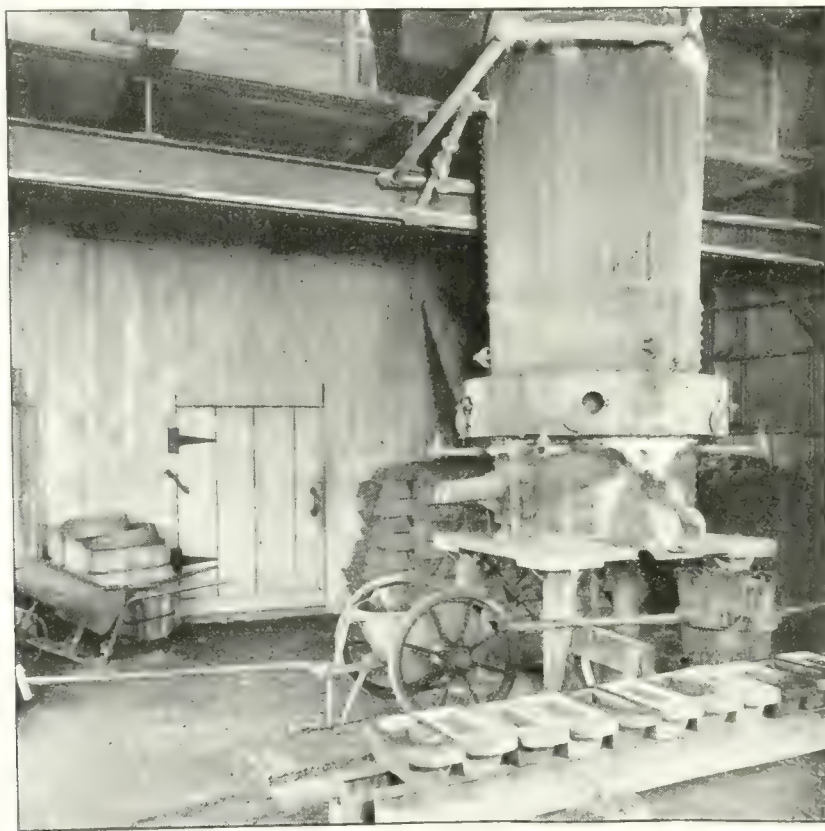


Fig. 4—Cupola for Reclaiming Refuse Metal, Showing Slag Buggy at Left

foundries accumulate such a quantity of refuse, but investigation will not be wasted that leads to an appreciation of the importance of the reclaiming of brass foundry sweepings.

Science in the Brass Foundry

A few years ago the melting and mixing of brass and other alloys were considered a mystery which was understood only by a few men who had certain formulas handed down to them from generation to generation. The truth of the matter is 50 per cent. of their mixing and practice was guess work, and if they sometimes made good metal, it

but such will soon fall in line or go out of business, as the man in a rut cannot compete with one who is progressive, and who seizes every opportunity to increase his output by the use of new methods, and with the least possible help.

Every year marks improvements in mixtures and equipment, and it is only by the brass founders getting together and discussing all these problems that the art of making brass and castings of other alloys will be brought to perfection.

“Keep your eye on the Brass World and Platers’ Guide.”

THE ECONOMY AND EFFICIENCY OF COPPER CYANIDE

Various Solutions Are Given for Plating Different Classes of Work, With a Few Remarks on Current Density

By Charles H. Proctor*

As electro-plating has been fully treated from a scientific standpoint in previous articles it is my intention to take up the practical side of electro-plating and give a demonstration by preparing copper and brass solutions. In these solutions I shall plate the various metals such as cast iron, zinc, steel, antimonial lead alloys and die casting metal.

In the past, copper solutions have been prepared with various materials. The majority of platers used so-called copper carbonate, which is in reality a sub-sulphate of copper, the metal contents of which varies from 45 to 52 per cent. Some platers are still preparing solutions with copper acetate, which tests in the neighborhood of 30 per cent. copper, and others are using cupri-cupro sulphite of copper, which is known in the market as red copper compound, testing about 40 per cent. copper.

Enormous Waste

Although the plater knew that of these materials the metal was the only ingredient of value to him, still he was forced to use such impure salts. He, of necessity, had to add about 50 per cent. of inert matter when using the so-called copper carbonate, 60 per cent. when using cupri-cupro sulphite of copper, 69 per cent. when introducing acetate of copper. You can readily appreciate that after a few additions of metal salts the bath became filled with these inert salts and impurities, increasing the density of the bath to such an alarming proportion as to necessitate the dilution of the solution and finally the discarding of the plating bath. The plater realized that this was a most expensive operation, and has therefore looked for a material free from impurities which would make this waste unnecessary.

The silver plating industry first realized the enormity of this waste and silver cyanide has been used in the large silver plating establishments for the past generation or two, having displaced silver chloride and

silver nitrate. The platers of copper, brass and bronze who had to deal with base metals have not given this wasteful practice the consideration it deserved, but as the plating of brass and copper is assuming such large proportions, the plater has been forced to give this matter his attention.

Every plater knows that no matter what copper salt is used in a cyanide solution, it must first be converted into a copper cyanide and then cut down with sodium cyanide to form the double sodium copper cyanide. He has endeavored to secure a chemically pure copper cyanide, as with such a material he would introduce into his bath only the active ingredients necessary for results, that is, metal and cyanide, and at the same time eliminate one operation—the conversion of the carbonates, etc., into copper cyanide.

Copper cyanide is nothing new. It has been available for years, but unfortunately it could only be obtained at a price which made its use prohibitive. The plater has had to continue the use of impure salts. He has had to continue clogging up his solutions with dead salts, which, while they gave results for the time being, forced the plater to discard, or at least partially discard, the baths when they became too dense. Every plater knows that a dense solution is harder to manipulate and control and that it requires more current to get a satisfactory deposit. He has had to contend with an unknown factor, the nature of which he had no way of determining. Recently, however, copper cyanide has been put on the market at a price which not only makes its use possible, but which actually results in a decided saving in chemical costs.

Copper Cyanide Chemically Pure

Chemically pure copper cyanide, testing 70 per cent. copper, the balance of 30 per cent. being pure cyanogen, is now at the disposal of the plater. He knows that with such a chemically pure salt a solution can be made up which will contain only that which is necessary for results, and knowing

*From the *Bulletin*, published by Lewis Institute, Chicago.

this, the solution can be controlled with absolute certainty. As the plater is constantly striving to better his conditions and putting his plating department on a sounder basis, it will only be a matter of a comparatively short time when this high grade metal salt will entirely displace the copper salts heretofore used in cyanide solutions. Why should a plater continue using so-called copper carbonate, which contains about 50 per cent. impurities and which must first be converted into a copper cyanide, when he can introduce chemically pure copper cyanide into his bath direct, especially when a solution made up with chemically pure materials can be controlled with absolute certainty? When the bath needs metal, the plater adds it in the form of copper cyanide, and when it requires cyanide, he adds it in the form of sodium cyanide. In other words, he is now able to make up a solution which will give the best possible results in the shortest time and remain constant and well balanced.

Solution

In the solutions which I will prepare, I will confine myself strictly to chemically pure materials. The copper bath will be prepared as follows:

Water	5 gallons
Copper cyanide	15 ounces
Sodium cyanide	15 ounces

I will prepare the brass solution according to the following recipe:

Water	5 gallons
Copper cyanide	15 ounces
Zinc cyanide	5 ounces
Sodium cyanide	20 ounces

Of course, by the elimination of the inert salts, the solution will be less dense. The copper solution will stand about 3½ deg. Baume. In making up a copper bath I have only used 6 ounces of chemicals per gallon, while to make up a solution of the same metal contents with copper carbonate, I would have to use over 12½ ounces of material per gallon, thus increasing the density over 100 per cent. To make up a copper bath of five gallons to contain the same amount of metal as this solution contains, it would be necessary to use 21 ounces of copper carbonate. To put this in solution so as to obtain sufficient free cyanide for results it would require about 42 ounces of sodium cyanide.

It is time that the practical electroplater discarded the Baume scale as a test for solu-

tions, as any material that is soluble in water adds to the density of the bath and the Baume scale, therefore, does not give the plater any idea of the condition of his solution. With the constant addition of metal salts which contain large proportions of inert matter, the density will rapidly increase, while the solution may be practically void of metal. The plater must use chemically pure materials or else discard the Baume scale as an index to the condition of his bath.

Relative Cost

The cost of the copper solution is 12 cents per gallon, while to make up a solution with the same metal contents, using so-called copper carbonate, would cost the plater about 25 per cent. more. When we take into consideration that many plants operate thousands of gallons of solution, this economy is a considerable item. On the face of it the metal cyanides appear more expensive. The market price of copper cyanide is from 42 to 45 cents per pound, while the so-called copper carbonate is quoted at 14 cents per pound. The plater must not lose track of the fact that copper carbonate or copper cyanide either, for that matter, has absolutely no value as such. It only becomes of value to the plater when put in solution with cyanide. It is here that the plater saves. He requires only about one-third the quantity of cyanide to put in solution a given amount of copper in the form of copper cyanide as compared with copper carbonate. For instance, the cost of one pound of copper cyanide (70 per cent. metallic copper) put in solution with sufficient free cyanide to obtain an immediate deposit is—

1 lb. copper cyanide, at 42c. per lb.....	42c.
1 lb. sodium cyanide, 29 per cent., at 22c. per lb.	22c.
	64c.

To put in solution the equivalent amount of metal in the form of so-called carbonate of copper, 50 per cent., you require—

1 lb. 6 ozs. copper carbonate at 14c. per lb.	19¼c.
2 lb. 12 ozs. sodium cyanide, 29 per cent., at 22c. per lb.....	60½c.
	79¾c.

Another factor which must be considered is the current density. It is a well known fact that a dense solution requires a higher electrical pressure, as the inert matter from the metal salts acts as a retarding agent. Of course, the rapidity of the deposit is governed by the ampere law, which teaches us

that the more amperes which can be carried upon a given surface the more rapid will be the deposit. The inert matter being eliminated by the use of the metal cyanides, the plater is able to increase the amperage about 25 per cent., and this enables him to reduce the time necessary for results, increasing the output accordingly. The plater, therefore, is able to turn out more work in a given time without increasing his tank area, which is another decided economy.

Thus neither copper carbonate nor copper cyanide as a single factor must be taken as a basis of calculating their relative costs in the plating solution, but when we take the solution complete, ready for operation, as a basis, there can be no doubt that with chemically pure materials the plater not only obtains a solution of maximum efficiency, but is able to materially reduce the plating costs. Once this fact is brought home to the plater, it will be a comparatively short time when chemically pure metal cyanides will entirely displace the materials of doubtful purity formerly used.

Standard Solution

The fact that all copper salts in a cyanide solution must first be changed to a copper cyanide simplifies matters greatly, as copper cyanide can be added to any copper cyanide solution, no matter what salt was originally used to install the bath in question. The plater has obtained results with materials which were at his disposal, but it was always with a degree of uncertainty as to how the bath would behave. This uncertainty is entirely removed once a plating solution is standardized, and this ideal condition can only be reached with the use of metal salts which are correct from a theoretical and practical standpoint, and it cannot be disputed that the only metal salts which answer these purposes are the metal cyanides.

Flux for Brazing

A flux for use in brazing cast iron or steel parts is the invention of J. Abt, Sydney, New South Wales. The proportions stated to have been found most suitable for the purpose are as follows: Clean and finely powdered steel or iron, 60 parts; borax 20 parts; petroleum or coconut oil 10 parts; naphtha 10 parts. These ingredients are mixed together to form a paste that can be applied readily to the surfaces to be brazed.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES.

New York—Meets fourth Friday of each month at Broadway Central Hotel, New York City, at 8 P. M. Secretary, Joseph Minges, 148 Schenck Avenue, Brooklyn, N. Y.

Rochester—Meets second Friday of each month at Hotel Rochester. Secretary, C. V. Haring, 306 Dewey Avenue, Rochester, N. Y.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa., 8 P. M. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Dayton—Meets first and third Wednesday at the Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 Madison Avenue, Irvington, N. J.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 1st Street. Secretary, Geo. J. Kutzen, 518 Alfred Street, Detroit, Mich.

Chicago—Meets fourth Saturday of each month at Western Building, Randolph and Michigan Aves. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Indianapolis—Meets twice a month on Friday evenings. Secretary, pro tem., J. C. Davenport, 349 Massachusetts Ave., Indianapolis, Ind.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, John G. Murphy, 71 Dingsen Street, Buffalo, N. Y.

Milwaukee—Meets first Friday of each month at Eagles Hall, 137 Second Street. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Ave., Cincinnati, Ohio.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, H. H. Williams, 2134 Nebraska Ave., St. Louis, Mo.

Bridgeport—Meets on the third Friday of each month at 260 John St., Bridgeport, Conn. Secretary, Nelson Barnard, 858 Howard Ave., Bridgeport, Conn.

Cleveland—Meets second and last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Ave., Cleveland, O.

Annual Convention of the American Electro-Platers' Society

The third annual convention of the American Electro-Platers' Society will be held at the factory of The National Cash Register Company, Dayton, Ohio, on the third, fourth and fifth of June, 1915. The business sessions will be held in their Hall of Industrial Education and the Round Tables in the evenings will be held at the Algonquin Hotel, which has been selected as headquarters. A number of excellent

committee suggests that everyone bring samples of their work or product, and write Mr. A. Lamoureux, 500 E. First St. Dayton, Ohio, Chairman Exhibit Committee, stating the amount of space required and space will be reserved.

Conditions for housing the convention at the N. C. R. plant are ideal. A magnificent chemical and physical research laboratory and a splendidly equipped electrical laboratory, along with the largest and one of the best equipped plating rooms in the country will be open to the inspection of the



Headquarters A. E. S. Convention

papers have been prepared for discussion at these sessions. The convention is to be an open one and all who are interested in electro-plating in any way are invited to attend.

The exhibit of samples of work and of equipment and supplies by the supply houses will be in the rotunda of The Hall of Industrial Education and dealers who may wish to make a demonstration of supplies or equipment will be furnished with space and facilities in the plating department of the National Cash Register Company.

It is the intention to make the exhibit one of the features of the convention and the

delegates and visitors to the convention. Nowhere else in the United States could be found a place where the activities of a convention of this kind be so well centralized or where so much of interest to the electroplater be found under one roof. Arrangements have also been made with some of the leading manufacturers to open their plants for the inspection of those attending the convention.

Rooms at the hotel may be secured at from \$1.50 per day up, without bath and \$2.50 per day up, with bath. The committee suggests that delegates and visitors reserve their rooms in advance, if possible.

A "Seeing Dayton" trip and a visit to

Hills and Dales, the most beautiful private park in America, will afford a pleasant break in the work of the convention. Nothing has been left undone by the committee in charge to make the convention both pleasant and profitable to all who attend.

The Convention will close with the annual banquet at the Algonquin Hotel, Saturday evening, June fifth.

A program of the Convention follows below:

PROGRAM

Third Annual Convention of the American Electro-Platers Society

National Cash Register Company, Dayton, Ohio.

June 3, 4, 5, 1915.

Thursday, June 3.

Registration.

(Hall of Industrial Education) N. C. R. Co.

10:00 a. m. Opening session, report of Credential Committee, introduction of delegates, annual address by the president.

2:00 p. m. Business session, report of officers.

8:00 p. m. Round table, papers, addresses and discussions.

Friday, June 4.

10:00 a. m. Business session.

2:00 p. m. Business session.

8:00 p. m. Round table, papers, addresses and discussions.

Saturday, June 5.

9:00 a. m. Business session, election of officers, choosing next convention city.

7:00 p. m. Annual banquet.

Every indication points to the fact that this is going to be the best convention ever held by the society and none actively engaged in the plating business or interested in electro-plating can afford to miss it. Come to find out what the other fellow is doing and how he is doing it—come and get in touch with the latest developments of the industry and the most approved apparatus and methods, and last—but not least, come and get acquainted with the members and enjoy their good fellowship.

We understand that it has been decided to place these conventions on a business basis, by charging the delegates and visitors a small sum to cover banquet and entertain-

ment expenses. This plan has been in effect for some time by almost all of the larger associations, such as the American Foundrymen's Association, and in view of the fact that almost all of the future conventions must be staged by the smaller branches of the society, and the expense, if borne by them entirely, would bankrupt them, the Dayton committee has decided to take this action and form a precedent which other branches may be glad to follow in the future.

BRANCH MEETINGS

The April meeting of the St. Louis branch was held on April 24th, and was very interesting in many respects. The election of representatives to the annual convention at Dayton, O., resulted as follows: H. J. Richards, E. J. Musick and H. H. Williams, delegates; H. Deubelbeis, E. W. Heil and S. S. Gaus, alternates. It was also decided to have an exhibit. The class in chemistry has been closed for the summer, and the members are well pleased with the results accomplished during the winter.

The following invitation has been sent out by the Milwaukee Branch regarding an informal dinner to be given on May 22nd:

"You are cordially invited to attend an informal dinner to be given by the Milwaukee Branch of the American Electro Platers' Society, at the Hotel Maryland, May 22, at 8:00.

"This society is a national organization, composed of superintendents and foremen of plating plants and its purpose is to improve methods in all branches of the plating industry.

"It maintains research bureaus in various cities and its members by cooperation in the interchange of ideas and experiences, endeavor to increase the efficiency of the plants under their management.

"The Milwaukee Branch, which has been in existence for upwards of a year wishes to secure the cooperation of Milwaukee Manufacturers in this matter of vital importance to both employer and employee.

"After the dinner addresses will be made by Mr. Wm. Geo. Bruce of the Merchants and Manufacturers' Association, and by Professor Burgess and Dr. Watts of the University of Wisconsin, both well known authorities on electro-plating chemistry and

by several chemist members of the society.

"We are inclosing reservation cards and trust that this dinner may be attended by the members of your firm as well as your superintendents and foreman platers.

"Kindly send in the reservations as early as possible in order that all arrangements may be completed and the success of the meeting assured.

We understand that the price per cover is \$1.25 each.

The first open meeting and smoker of the Cleveland Branch was held at the Pythian Temple, Cleveland, Ohio, Saturday evening, April 24, 1915.

The smoker from the viewpoint of the Branch was a success, there being a large attendance, and a number of the platers handed in their applications for membership. After the luncheon was served, William Scott, the president of the Cleveland Branch, acting as toastmaster, addressed the members and guests, welcoming them and setting forth the reason for the gathering. He then introduced Mr. H. J. Ter Doest who read a letter from Supreme President J. H. Hanjosten (Mr. Hanjosten being unable to attend) setting forth the advantage of becoming a member of the A. E. S.

Other speakers of the evening were: Messrs. R. H. Sliter, and H. J. Ter Doest, and A. D. Sopher. A large number of the members exhibited samples, that aroused a great deal of interest, and discussion as to their production.

Exhibit Space at Atlantic City Conventions

All manufacturers and dealers in machines, tools, equipment and supplies for the metal manufacturing industries are cordially invited to make an exhibit at the forthcoming annual conventions of the American Foundrymen's Association and the American Institute of Metals to be held in Atlantic City in September.

These conventions will be held on Young's Million Dollar Pier from September 25th to October 1st. As this is the first time in many years that these national conventions and exhibits have been held in the East, and a record attendance is looked for from all the Eastern and New England States, together with a large representation from

the Middle West, attracted by the opportunity for combining pleasure with business at America's great seaside resort.

The accommodations on the Pier are exceptionally good and exhibits of all kinds can be installed and demonstrated. For operating purposes the following power facilities will be available: Steam, compressed air, electricity (alternating current 220 volts, 60 cycle, 1 and 3 phase; direct current 110 and 220 volts), and illuminating gas. A nominal charge will be made for power used. The management will be pleased to co-operate with exhibitors, as in the past, to secure the rental of motors.

In addition to the annual exhibition permit fee of \$25.00 there will be a charge of 50 cents a square foot for exhibit space. Booth construction, signs, general decorations, janitor, police and watchman service, etc., are all provided without extra charge.

Freight shipments can be made direct to Young's Million Dollar Pier, care of Eldredge Express and Storage Co., and delivered to your space, and at the close of the exhibit will be returned to the railroad, at \$5.50 per ton for the round trip. Crates, boxes, etc., used in shipping will be removed and stored, and returned without extra charge.

Schedule of rates for mechanics, electrical work, florists, furniture, etc., recommended by the management, will be issued later, in sufficient time to make provision for the above requirements.

Hotel accommodations are unusually good and reasonable rates can be secured on either European or American plan. Complete schedule of rates will be furnished later.

The November and March numbers of the Exhibition Quarterly contain considerable general information about the Atlantic City conditions, as well as a list of the 1914 exhibits and exhibitors. Extra copies will be sent on request.

Copy of Rules and Regulations with floor plan and formal application blanks will be mailed about June 1st. For further information address The Foundry and Machine Exhibition Co., 1949 W. Madison St., Chicago, Ill.

Scrap should be kept in separate bins, when it may be resold to the foundries from which castings are bought at twice the price of scrap.

QUESTIONS AND ANSWERS

All communications under this head should be addressed to the "Questions and Answers Editor"

Naval Brass

Please advise the proper pouring temperature for making naval brass which is to be used for extruding purposes.

ANSWER.—2,100° F. is about the proper temperature.

Deposit by Dipping

We have had difficulty in getting a light deposit on nickel, brass and copper articles by dipping. We enclose a sample on which the deposit was put on by dipping. This is the finish we would like. Please advise how it is done.

ANSWER.—We would suggest that if you have not already tried the following formula, perhaps this will help you:

Water, 1 quart; nickel chloride, 7½ drachms; sodium phosphate, 8¼ oz.; ammonium chloride, 11¼ drachms; ammonium carbonate, sodium carbonate, each 4¾ drachms. Use a piece of pure magnesium or aluminum for contact. Use solution boiling hot.

Galvanizing Solution

Can you tell me why my galvanizing solution does not plate a nice white color all over? In some parts it is white and in others dark. I use a barrel and 100 and sometimes 120 amperes. I have good anodes and I added some zinc, about 25 pounds to 150 gallons, and still it does not plate a good, even deposit. Should the work be dried the same as other plated work?

ANSWER.—A good formula for electro-galvanizing is as follows:

Water	1 gal.
Zinc sulphate	2 lbs.
Aluminum sulphate	4 oz.

Use cold.

Your trouble is perhaps due to too strong a current, or impurities in the zinc solution. The aluminum in the above formula has a toning effect.

Titanium Aluminum Bronze.

In the April issue we replied to an inquiry on the determination of titanium in titanium aluminum bronze. We have since received a letter from the Titanium Alloy Manufacturing Co., Niagara Falls, New York, regarding a method which they have worked out on this material and which they claim will show titanium without fail, if it is present. This method is as follows:

Dissolve 5 grams of drillings in 10 c.c. of HNO₃ and 50 c.c. of water. Boil to remove brown fumes. If any residue remains, it should be filtered off, and ignited at a low temperature in a platinum crucible, then treated with a few drops of HNO₃ Sp. Gr. 1.42, 3 c.c. of H₂SO₄ Sp. Gr. 1.84; 3 c.c. of H F and evaporated to fumes of sulphuric anhydride.

The copper is removed from original solution either by zinc or by electrolysis. If by the former the solution must be treated with H₂SO₄ and evaporated to fumes. If by the latter the acidity is right for deposition, and the copper can be removed in about an hour when using a rotating apparatus or solenoid.

After the removal of the copper the two solutions are combined. The aluminum, iron and titanium are precipitated in the cold by NH₄OH Sp. Gr. .90. A small amount of the aluminum may not be precipitated but all of the iron and titanium will be.

The precipitate is filtered off, using a Buchner funnel, washed thoroughly with hot distilled water. Reject filtrate. Remove precipitate and filter paper to convenient size beaker and treat with 7 c.c. H₂SO₄, Sp. Gr. 1.84 and 50 c.c. of water. Digest for some time on hot plate to insure complete solution. Filter, wash. Evaporate filtrate to a volume of about 40 c.c. and determine the titanium by color.

Color Method for Titanium.

The solution containing the titanium is placed in a Nessler jar and 2 c.c. of the

standard peroxide solution added. A yellow coloration indicates titanium. The same depth of color is then obtained in another jar by the use of a standard titanium solution.

Preparation of Standard Solutions Used in Titanium Determinations Peroxide Solution.

Dissolve 4 grams Sodium Peroxide in 125 c.c. of dilute H_2SO_4 (1:3) and dilute to 500 c.c.

Strong Titanium Solution.

Dissolve one-fourth gram of standard 20 per cent. carbonless ferro-titanium in dilute H_2SO_4 (1:3); when completely in solution, oxidize with the least possible amount of HNO_3 ; boil for a few minutes, cool and dilute to such volume that 1 c.c. contains .0005 gr. of titanium.

Dilute Titanium Solution.

This solution is made just before making the determination by diluting 1 c.c. of the strong solutions to 10 c.c. Each c.c. then contains .00005 gr. of titanium.

When using a 5 gr. sample 1 c.c. equals .001 per cent. titanium.

Oxidized Nickel Finish

Is there such a thing as a dip that will oxidize small nickel plated articles? Of course, I can use the black nickel solution and plate them, but I am looking for a quicker way, if that is possible.

ANSWER.—The black nickel is best. You might try a solution of water, 1 gallon and liver of sulphur, 3 oz., on your work.

Bronze Formula

We would like to obtain a formula for a bronze having a hardness of around 100 Brinell, with as much ductility as possible.

ANSWER.—The following formula will meet the requirements stated for hardness. Copper, 85 per cent.; tin, 12 per cent.; phosphor-tin, 1 per cent.; zinc, 2 per cent.

This alloy, however, does not possess any great amount of ductility, although this quality may be increased by cooling the castings in water. We believe manganese bronze would be more serviceable, provided the castings are of such a nature that this alloy can be used.

Lead Cable

We have an opportunity to purchase a considerable amount of heavy lead covered

insulated cable as scrap, but do not know whether there would be profit or loss in the transaction, as we do not know how much metal there is per foot of cable. Can you advise us? The cable is 1 9-16 inch in diameter.

ANSWER.—The cable ought to weigh a little over $5\frac{1}{2}$ pounds per foot, made up as follows: lead, $2\frac{3}{4}$ pounds; copper, $2\frac{1}{4}$ pounds and gum 9 ounces. These figures have been actually taken from a section of such cable and will give a pretty correct idea of the value of such scrap.

Manganese Bronze and Tobin Bronze

We would feel greatly favored to receive a formula for manganese bronze, suitable for both large and small castings; also a mixture for making Tobin bronze.

ANSWER.—The following formula is most generally used when manganese bronze is specified: Copper, 56 pounds; zinc, 43 pounds; steel alloy, 2 pounds; aluminum, $\frac{1}{2}$ pound. The steel alloy is made by melting together ferromanganese, wrought iron and tin in the following proportions: Wrought iron, 18 pounds; ferromanganese, 4 pounds; tin, 10 pounds. This is the formula religiously adhered to by many makers of this alloy, but there is no reason why it should be made in this way, as the steel alloy is a nuisance in any foundry, and it is not at all unusual for half of the tin to be lost in making it, and the iron has been known to absorb as much as 5 per cent. of carbon, with the result that the alloy is thrown out of balance and the bronze does not come up to requirements.

Considering these things, therefore, unless the inquirer is well versed in making the steel alloy, we believe the following formula will prove more satisfactory:

Melt 55 pounds of copper under charcoal, when thoroughly liquid add 1 pound of 30 per cent. manganese copper; stir the mixture and add 1.25 pounds of clean tin plate, push to the bottom of the copper and stir until dissolved; then add $\frac{1}{2}$ pound of aluminum, which will ensure that all the iron will go into solution; then add gradually 43 pounds of a good grade of zinc; stir thoroughly; add 0.75 pound of tin, give another stirring and the metal is ready to pour. Be careful not to volatilize any more of the zinc than absolutely necessary, for although volatilization is allowed for in the formula, the less there

is the better the alloy will be as regards tensile strength and elongation. The tensile strength should be over 80,000 pounds per square inch, and the elongation at least 24 per cent. on 2 inches. The analysis will show: Copper, 55.50-56.00 per cent.; zinc, 40.80-41.5 per cent.; iron, 1.15-1.20 per cent.; tin, 0.70-0.78 per cent.; manganese, 0.16-0.22 per cent., and aluminum, 0.45 per cent.

Tobin bronze is very similar to manganese bronze, minus the aluminum; the following is one analysis: Copper, 57.55 per cent.; zinc, 40.02 per cent.; tin, 1.48 per cent.; lead, 0.50 per cent.; iron, 0.40 per cent. An analysis of the spelter should be made to determine its lead content before any addition of lead is made to the alloy.

Magnalium

Can you inform me how the aluminum alloy, known as magnalium, is made? I would like to obtain a formula suitable for casting parts of scientific instruments that will machine well and be strong.

ANSWER.—The following alloy will be found satisfactory for the purpose outlined:

Aluminum	92 per cent.
Magnesium	7 per cent.
Zinc	1 per cent.

Solution for Die Casting.

Please send me a formula for a bright brass solution, which is composed of carb. copper, carb. zinc, cyanide, carb. soda, bisulphite sodium and water? This solution is used for die casting as well as hard metals.

ANSWER.—The following is the formula you desire:

Water	10 quarts
Carb. of Soda.....	10 1/2 oz.
Bisulphate of Soda.....	7 oz.
Copper Carbonate.....	3 1/2 oz.
Zinc Carbonate.....	3 1/2 oz.
Potassium Cyanide to clear	

We would suggest that you substitute copper and zinc cyanides for the carbonates in the same proportions as above.

Cyanide Silver Solution

We would like to have some information regarding the precipitating of a cyanide silver solution. Also a nitrate solution, and want the most simple way.

ANSWER.—Hydrochloric acid will do it. We would refer you to an article in the

BRASS WORLD of March, 1908, and June, 1908, which may be of help.

Phosphor Tin

Please advise how we can make 5 per cent. phosphor tin.

ANSWER.—Melt your tin and then plunge phosphorus (with phosphorizer) under the surface of the tin quickly. Good reliable brands of phosphor tin are now obtainable in the market, and in most cases it is much more satisfactory to buy the prepared article.

Coloring Copper.

A subscriber writes us as follows:

I have succeeded in producing a most satisfactory color on copper by the use of liver of sulphur by the following methods, which may be of interest to other readers of the BRASS WORLD:

Use a small piece of liver of sulphur, about the size of a fingernail, to a pint of water, bring to a boil and then dip the copper, which has been thoroughly cleaned, in the solution, leaving it in until it turns black. Dry it and rub down to the desired effect with wet powdered pumice, finally finishing with wax to preserve the color and give it a gloss.

Another method which gives a good red-brown color is as follows:

Take what is known as red French chalk, powder a little of it and mix with ammonia into a thin paste so that it will spread on the work like paint. Apply with a soft brush. Dry it over a fire. Brush off the paste with a stiff brush and a reddish color will be the result. Then take a stiff cloth, wax it, sprinkle a little flaked graphite on it and rub it on the copper until the color is the desired red-brown shade.

Cleaning Pitted Bronze

We have some large pieces made from bar bronze on automatic screw machines. In making the pieces we used soda water as a lubricant and the pieces have now been made for several weeks and when we started to use them again we find they are discolored, and it is next to impossible to get them absolutely clean. They are green, and some pieces are almost black, and while we have tried to wash them in sulphuric acid we cannot get them absolutely clean. Any information you can give us would be much appreciated.

ANSWER.—The strong caustic has eaten

into the bronze, and the only way to remove the discoloration will be to immerse the bronze in acid long enough to counteract the effect of the alkali. This is, of course, harsh treatment and will probably leave the bronze pitted. After the bronze has become cleaned by this acid, it will be necessary to remove every trace of acid by carefully washing with water; and hot water is more

efficient than cold. Not knowing how badly your bronze is discolored it is difficult to say how strong to make the acid. Would suggest, however, that you try nitric acid, gravity 1.42, and add an equal volume of water. This will attack the bronze slowly but vigorously. If too strong, dilute with water; if too weak add more acid, or heat original solution.

Producer Gas in the Foundry

By T. McFARLANE.*

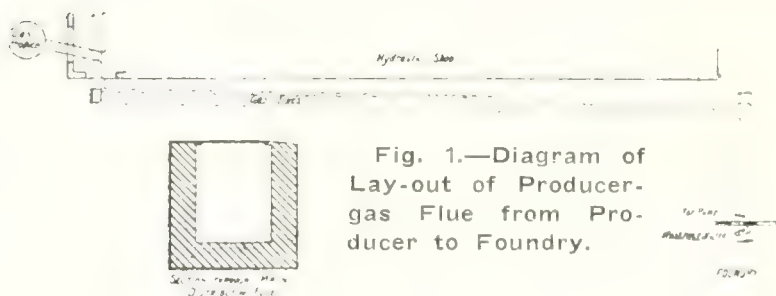


Fig. 1.—Diagram of Lay-out of Producer-gas Flue from Producer to Foundry.

Drying by producer gas (in core-ovens, stoves, etc.) is of great convenience and economy compared with open fires made with coal or coke, and from the point of view of perfect control, cleanliness and uniform drying at moderate temperatures, such a system has much to commend it. The writer has had seven years' experience of producer gas in constant use in the foundry, and would not like to go back to the days of open fires and their constant smoke, fumes and obnoxious gases. Only a portion of the gas generated, however, is used in the foundry, the bulk being required for heating plate and angle-bending furnaces of different types. The producer is placed in a convenient position for serving these furnaces, and the gas has consequently to be carried a long way to the foundry. The portion of the layout from producer to foundry is shown diagrammatically in Fig. 1.

The producer itself is of the ordinary standard Wilson water-bottom type. Briefly it is a cylindrical steel casing, brick lined

and constructed with a water-luted bottom to facilitate continuous running. When working it is kept nearly full of coal from top to bottom. Into the center of this mass of fuel near the bottom and as far as possible from the side walls, air and steam are injected from the central tuyere. A rapid combustion

takes place in the vicinity of the tuyere where the carbon is decomposed into carbonic oxide at a bright red heat, and hydrogen also decomposed from the steam.

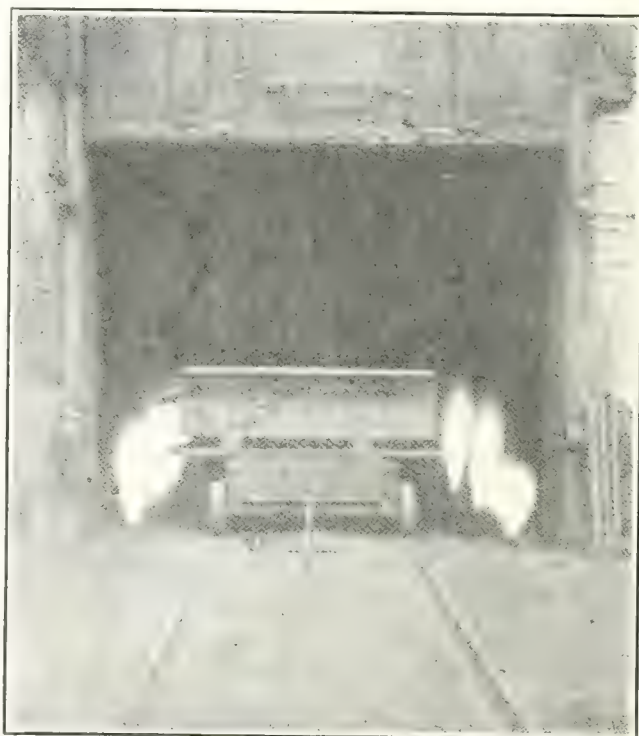


Fig. 2.—Mould-drying Stove with Six Burners.

* Paper read before the Birmingham Branch of the British Foundrymen's Association, February 27, 1915. Mr. D. Dalrymple in the chair.

The blast is forced into the bottom of the producer through a throat pipe by means of a steam jet and a steam pressure of about 40 lbs. is required for this purpose. The coal is charged from time to time through a bell and hopper at the top. The hydrocarbons in the "green" coal are distilled in the upper portion by the sensible heat of the



Fig. 3.—Lighting the Cupola with a Gas Jet; also Drying Ladles.

escaping gases from below, and by conduction, and join the carbonic oxide, hydrogen and diluent gases in their outward passage through a downcomer into a large brick flue 2 ft. wide by 2 ft. 6 in. high, the latter being covered with loose cast-iron plates in frames which can easily be removed and the flue thoroughly cleaned.

The following is a typical analysis of the Wilson gas:—Hydrogen, 15.0 per cent.; carbon monoxide, 25.9 per cent.; marsh gas, 1.4 per cent.; carbon dioxide, 3.7 per cent.; nitrogen, 54.0 per cent. Percentage of combustible, 42.3. British thermal units per cu. ft. of gas, 161.

The variation in the quality of the gas is very slight. The tar which condenses in the brick flue and cast-iron trough mains throughout the system gravitates to a tar sump, and is pumped from there into a steel barrel on wheels. It is afterwards stored in large tanks close to the railway siding for sale, its market value being usually about 20s. per ton. The quantity of tar varies, of course, with the distance the producer is placed away from the foundry

stoves and their proximity to one another. In our case this amounts to about 2 per cent. by weight of the coal burned in the producer. Where practicable it is advisable that the producer be as near as possible to the point of application, so that full use may be made of the sensible heat and the tarry gases, and the labor of cleaning flues be as little as possible.

Any ordinary bituminous coal may be burned in the producer provided it is of a non-caking nature, but it is not found to be good practice to use very fine slack. Small nuts, about $\frac{3}{4}$ in. to 2 in. cube are the most suitable; in any case there should not be more than 25 per cent. which will go through a $\frac{1}{2}$ in. mesh. The local coal we use contains:—Fixed carbon, 55.35 per cent.; volatile matter, 28.45 per cent.; moisture, 11.7 per cent.; ash, 4.5 per cent.

The gas as it enters the foundry is controlled by a mushroom valve with pillar and wheel, so that the supply can be shut off when one of the auxiliary valves or troughs requires cleaning. From this point the gas is conveyed where required under 3 or 4 in. of water pressure in rectangular cast-iron troughs. These trunk or main troughs, measuring 6 ft. long by 14 in. by 9 in. by



Fig. 4.—Line of Small Ladles Being Dried.

$\frac{3}{8}$ in. thick, run the full length of the foundry. They are let into the ground and fixed with a fall so that the condensed tar gravitates into the pits provided. Each trough connects up to the other with a spigot-and-socket joint and loose plates are placed on the top and rest on flanges butting up to

one another. The joints are made up with fireclay or loam. Out of this main trough the smaller branch mains lead, conveying the gas into the drying stoves, and also where required on the foundry floor. The small troughs are constructed exactly like the larger ones, but they measure only 6 in. by 4 in. inside, and the cover plates, 2 ft.

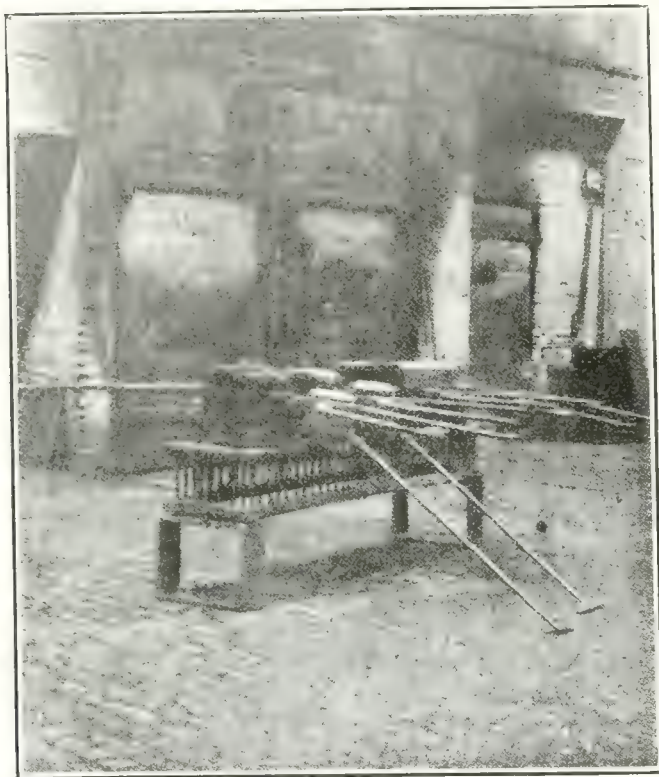


Fig. 5.—Old Form of Grate for Ladle Drying.

long by 6 in. wide by $\frac{3}{8}$ in. thick, have $1\frac{3}{4}$ in. diameter holes 12 in. apart. Into these holes taper plugs are fitted measuring $1\frac{1}{2}$ in. to $1\frac{3}{4}$ in. diameter by $1\frac{1}{2}$ in. deep. Each branch main is connected up to the trunk by means of a valve 12 in. square by 9 in. deep, with 6 in. inlet of mushroom type. These valves, which are easily operated by hand, allow of the perfect control of the gas in each section. Where heat is required the plugs are removed from the holes, the valves lifted and the issuing gases lighted, the valves may then be adjusted until exactly the required height of flame is obtained.

To sum up the foregoing we have, in short, a supply of gas which can be readily taken to any part of the foundry by the means described, and there burned with a smokeless flame for the purpose of drying. The drying demands in a foundry are numerous and varied in their special application.

Figs. 2 to 13 show the usual drying processes with gas applied. First, there is the

ordinary stove for drying molds and cores. The one in Fig. 2 measures about 15 ft. long by 9 ft. wide by 8 ft. 6 in. high. It is being heated by three gas jets burning on each side of the stove. More plugs can, of course, be removed if necessary, and more or less gas burned according to the work in hand and the time in which to accomplish it. A cylinder mold weighing, say, 40 cwts., would be stone dry after about 12 hours in this stove burning six jets. We have four stoves of varying sizes in daily use; they are all fired in the same way, and the valves operate from outside when the doors are down. Sight holes are provided in the doors, and the gas can be lowered before a man goes in to move or test the cores. No structural alterations are necessary in converting to gas. The old fire bars are knocked away and the gas flues laid in the floors. It is no small advantage over the old system that

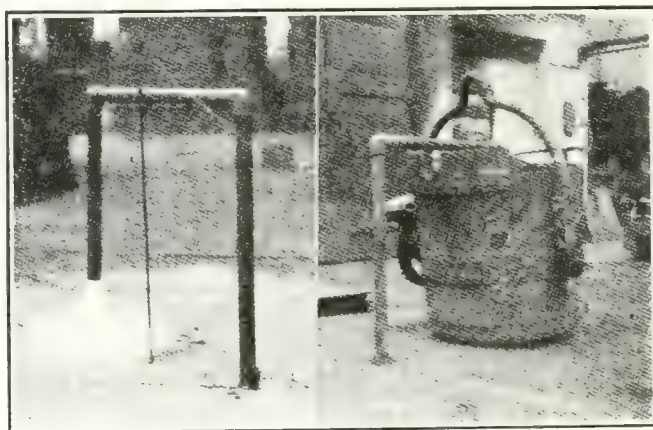


Fig. 6.—Gas Pipe for Drying Large Ladles.

Fig. 7.—Large Ladle in Position for Drying.

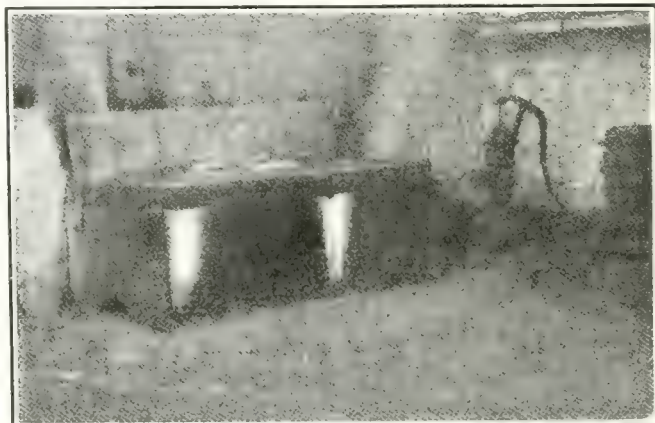


Fig. 8.—Drying Parting Sand.

now, when the stove doors are opened, there are no clouds of black smoke filling the foundry, and, further, it is no exaggeration to say that the foundry walls, if whitewashed, will be clean after one year.

When using oil-sand cores the writer found the gas-fired stoves admirable for drying, or rather baking, these special cores. In less than 15 minutes the temperature can be raised from cold to over 450 deg. F. Owing to the distribution of the jets an even temperature throughout the stove can be maintained, so that the cores are not some of them burned and others only half dried.

When a cupola is blown out every day,

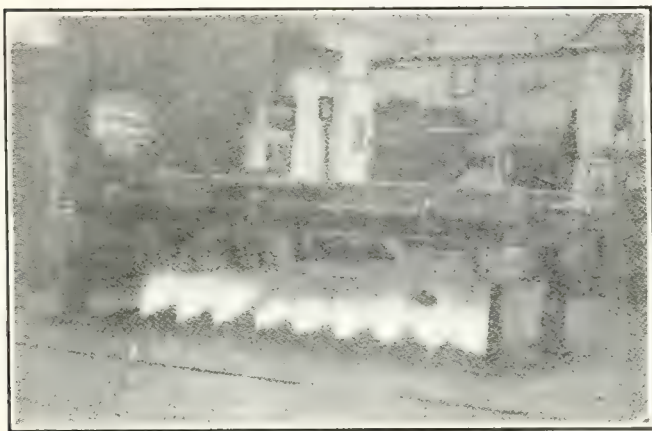


Fig. 9—Top Part of a Mold Being Dried Over Row of Jets.

lighting each morning can be done by gas without coal or firewood. In the old days we used at least 1 cwt. of coal and a riddle-full of firewood. Now it is a simple matter to fix the 2-in. pipe shown (Fig. 3) over an aperture in the flue and light the coke with a jet of gas. Further, I believe that lighting the cupola with coals tends to harden the metal, as coal contains more sulphur than coke.

Fig. 3 also shows the system of drying small ladles, and in Fig. 4 is shown a line of these ladles, large and small, resting on stands. When the ladles are freshly daubed they are placed over the gas in an upright position, and as soon as the loam is stiff the stands allow of the ladles being turned over and the drying completed from the inside. I have seen various methods adopted for drying ladles, brick and cast-iron fire-grates, both open and closed. They are generally outside the foundry and exposed to all sorts of weather. Large fires have to be lighted every day, and after the ladles are dry these fires are left to burn themselves out.

We used to have the form of grate shown, but find gas-firing is a great saving in both labor and fuel, and at least to

one born north of the Tweed, any form of waste in a foundry is unhealthy. For the larger ladles the gas is burned inside with the help of an inverted U-pipe fixed over the flue (Fig. 6). In order that the loam at the bottom of the ladle may not be in direct contact with the flame and burn the lining, it is advisable to interpose a piece of sheet iron to baffle and spread the flame. This, it will be admitted, is preferable to building a fire of coal and firewood inside the ladle. Parting sand may be dried on a hot plate over two jets (see Fig. 8) in a very short time, and with the minimum of labor. This corner of the foundry is the most remote from where the gas enters, and is at the extreme end of the gas troughs. The small hand pump shown is used for removing the tar, which is pumped out once a fortnight, about 5 cwts. accumulating in that time.

Owing to the ease with which the gas can be manipulated and conveyed from one point to another, and the smokeless flame with which it burns, uses are constantly found for it about the foundry floor. In Fig. 9 is seen the top part of a mold, which, on account of its size, would take time and trouble to put into a stove, being dried over a number of jets. Sheet-iron

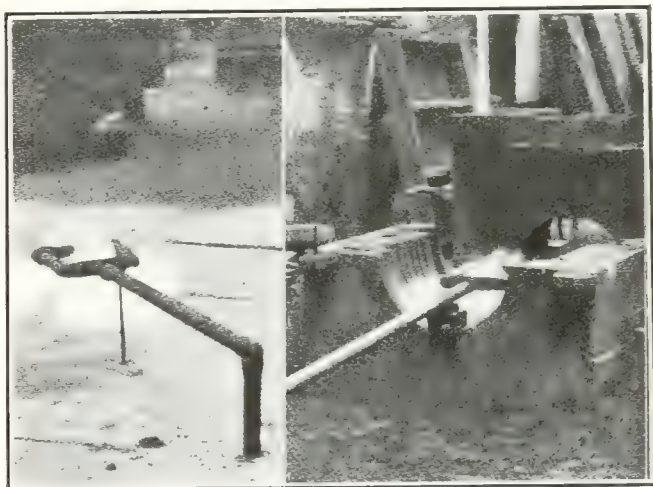


Fig. 10.—Burner for Drying Bottom Parts of Molds

Fig. 11.—Bottom Part of Mold Being Dried.

plates are placed round to keep in the heat, the whole arrangement making a very efficient and quick means of drying large top parts.

For bottom parts of molds a simple arrangement (Fig. 10) can be used, consisting of a burner made out of 2-in. diameter pipes, 12 in. square, rigged up so that the boxes can be dried in the position in

which they are molded, the heat being kept in by a covering of sheet iron. The burner is perforated with $\frac{1}{2}$ -in. diameter holes at 2-in. centres, and is easily cleaned over a blacksmith's fire should the holes become clogged with tar.

An old hand ladle with a few $\frac{1}{2}$ -in. diameter holes drilled in the bottom and sides when inverted over the gas jet makes an

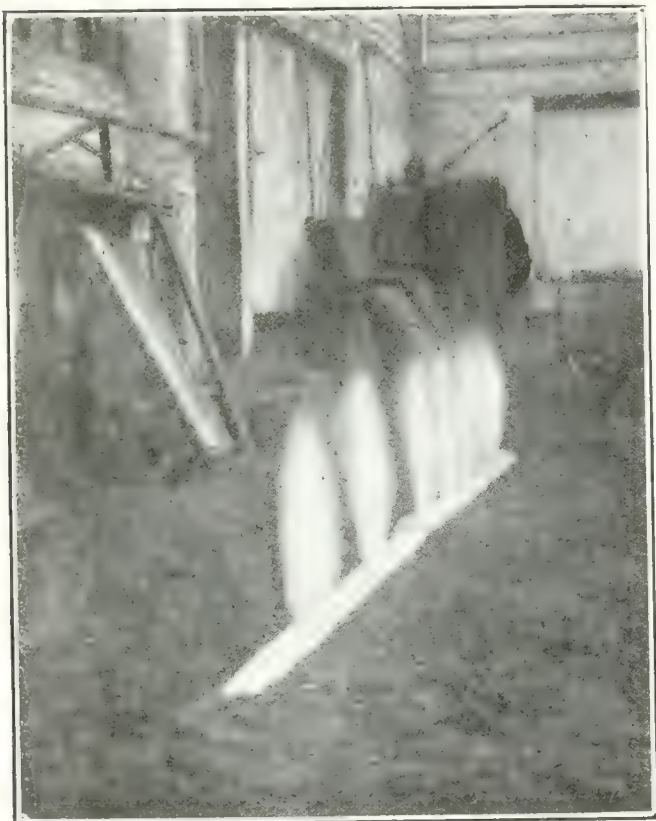


Fig. 12.—Cast-iron Pipe Line for Conveying Gas to Required Points.

excellent burner or spreader. Such an arrangement is in constant use for drying molds and pipes when cast on end. We use these burners for heating the foundry in cold weather. Apart from times of severe frost, when this is necessary for the condition of the sand, the weather is often too cold for molders to work in comfort, especially on Monday mornings, and when there are only half-day blows. Gas used for this purpose is not wasted—you cannot get the highest efficiency out of men when they are uncomfortable. Fig. 12 shows another means of conveying the gas along the foundry floor other than through the troughs, which are more or less in permanent positions; cast-iron spigot-and-socket pipes can be quickly laid down and the gas burned under the top parts of columns or where required.

There are many other simple appliances

and applications which might be described, but the writer will mention only one. Oil cores require high temperatures, and in the little stove shown in Fig. 13, used for baking small oil cores, a single jet is burned at the back and the hot gases drawn through the ovens by means of a dampered flue. Any desired temperature can be obtained up to, say, 550 deg. F., and the space above provides hot shelves for keeping the cores dry.

It is perhaps worth mentioning as showing the clear atmosphere which can exist in a foundry that nearly all the accompanying views have been made from photographs taken during working hours and in the winter months.

While the system described is simple, and the more it can be kept so the better, one does not always arrive at the simplest method right away. In getting to where we are we have had to go through troubles such as variations in pressures, resulting

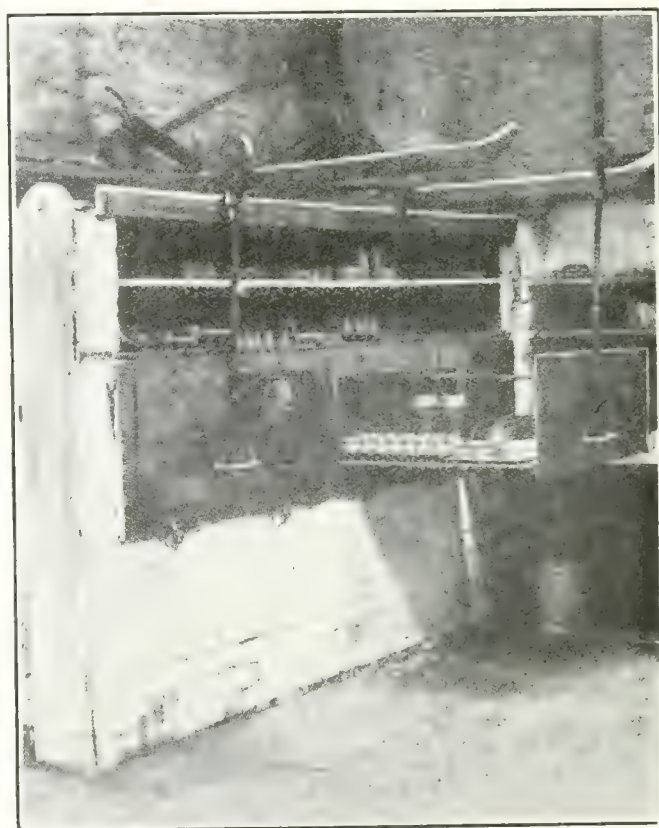


Fig. 13.—Small Gas-fired Stove for Small Cores.

in the gas constantly going out, explosions in the mains, when the men would bolt from the foundry like rabbits, and the continual trial and alteration in design of valves and appliances, always bringing us back to the simplest forms in the end.

Lastly there is the question of cost.

From a labor point of view gas is a distinct economy. Where the gas plant is used exclusively for the foundry the producer can be placed near the cupolas and attended to by the cupola men. The coal, instead of having to be distributed all over the foundry, is concentrated in one place, a truck load being tipped straight on to the producer platform. The cleaning of the flues and valves, if systematically carried out, is a simple matter. The wear and tear on the stoves, and, in fact, on the foundry generally, is infinitely less with gas than coal, and the producer can be safely run, on reasonable coal, for two or three years without opening up, and even then, on drawing the fire a few replaced bricks is all that is necessary.

One very important advantage in favor of gas is the increased capacity for work it gives to the stoves themselves. I have no hesitation in saying that quite half as many cores again can be dried in a gas stove as in a coal-fired stove of equal size.

As regards the relative weight of coal gasified compared with coal burned direct, in our case it is most difficult to obtain absolutely analogous figures. We have been up against the problem of metering large quantities of dirty gas, of ascertaining how much we are losing from the sensible heat and tarry gases which are eliminated in the 70 yards of flue through which the gas has to pass on its way to the foundry, and apportioning the gas used in the foundry and furnaces respectively, where in both cases the load is constantly varying. We assume, to be on the safe side, for costing purposes, the same weight of coal gasified per ton of good castings for drying as before with direct firing.

The plant itself, that is a complete installation consisting of producer, firebrick lining, platform, downcomer and valve delivered and fixed, say, of a capacity equal to 4 cwts. an hour, would cost approximately £200, and for 8 cwts. £275.

War Orders Via Canada

The latest and largest recent order for war munitions from the British government has been awarded the Canadian Car and Foundry Co., Montreal. It is for shrapnel and howitzer shells and totals \$22,000,000.

The company has sublet some of the ma-

chined brass parts to United States concerns.

The prospects are the British government will this month place large orders through the Shell Committee, headquarters in Montreal, for lyddite shells, with the different Canadian manufacturers.

The Influence of Acetylene on Metals

To determine the effect of acetylene gas upon metals and alloys a series of interesting experiments were conducted by H. Reckleben and J. Scheiber, two German investigators. The first experiments were made with pure dry acetylene, which was passed over the metals for a period of 20 months. The metals experimented upon were as follows. Brass, tombac, German silver, aluminum bronze, phosphor bronze, type-metal, solder and lead filings. In addition to the above the following metals were tested in powdered form. Zinc, tin, iron, copper, and nickel. The result was that none of the above mentioned metals or alloys were affected in any way by acetylene provided the gas was pure and dry. During the period the tests with the pure, dry gas were under way, other tests were being carried out with the impure, moist gas generated from commercial carbide, and the result was quite different to what was obtained with the pure, dry gas.

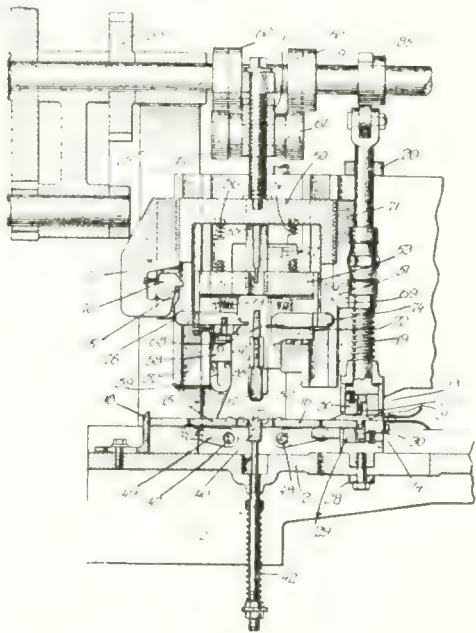
The unpurified, moist gas had no appreciable effect upon tin, tombac, German silver, type-metal and aluminum bronze. Brass increased in weight up to 0.9 per cent.; lead and zinc, 0.4 per cent.; iron 6.4 per cent.; gun metal 6.0 per cent., and phosphor bronze 14.4 per cent. Copper powder had completely blackened and increased in weight 92.00 per cent. in only six months; copper foil showed an increase of 80 per cent. in twelve months, and when the substance thus produced was treated with acids, traces of hydrogen sulphide were found but no acetylene, and the black residue resembled the carbonaceous product obtained by the action of acetylene upon copper salts. A very similar deposit has been observed in copper tubes employed in acetylene installations. In no case were explosive substances produced. When pure, moist acetylene was passed over copper an increase in weight of 1.6 per cent. was observed, and in the case of nickel an increase of 0.9 per cent. was noted.

New Patents

Treating Aluminate Solutions

A process of treating aluminate solutions for the purpose of removing silica, by diluting the solution to destroy the established equilibrium, and then subjecting the hot aluminate solution to the action of the residues from the decomposition of bauxite by alkali. The concentration is not to exceed 30° Baumé. Also a process of making aluminum hydrate by digesting bauxite with an alkaline-aluminate solution, and then diluting the resulting aluminate solution and removing the silica by further heating in presence of the undissolved residues. (U. S. Patent 1,137,860. May 24, 1913. Serial No. 769,615. Henry Howard, Brookline, Mass.)

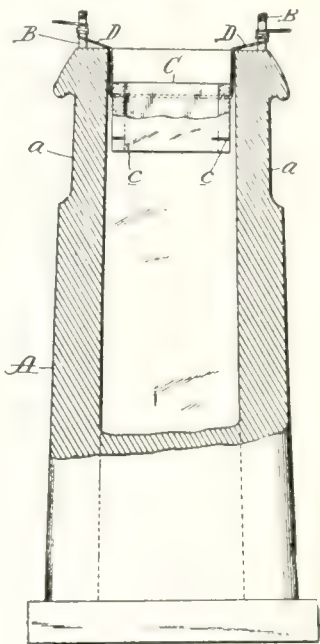
Seamed Tube Forming Machine



Supplying a means in combination for intermittently advancing a sheet metal strip, then a means of severing so as to form reverse bent hooks on the adjacent ends; a mandrel around which the severed blank is folded, and means for depressing the mandrel so as to clamp the central part of the strip in advance of its folding; also a means to fold the blank about the mandrel while thus clamped. A stop is on one side of the mandrel to vary the length to be fed, with the severing unit on the other side. The mandrel is adjusted to extend transversely of the blank, with a yielding block beneath for clamping the blank, and hinged wings on opposite sides of the

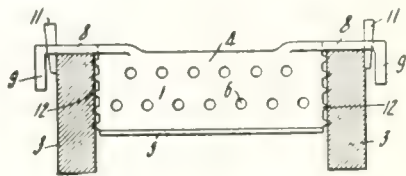
mandrel. (U. S. Patent 1,137,966, April 6, 1914. Serial No. 830,047. Otto J. Groehen, Detroit, Mich., assignor to Briscoe Mfg. Co., of same place.)

Ingot Mold



This mold is in combination with a feeder or sink head, through which the metal is poured, also a means for suspending the feeder in the mold in various horizontal planes below the top of the mold that may be flexibly adjusted. Wires are attached to the mold at its upper part to suspend the feeder in it. (U. S. Patent 1,137,264, Feb. 11, 1915. Serial No. 7,594. Emil Gothmann, Baltimore, Md.)

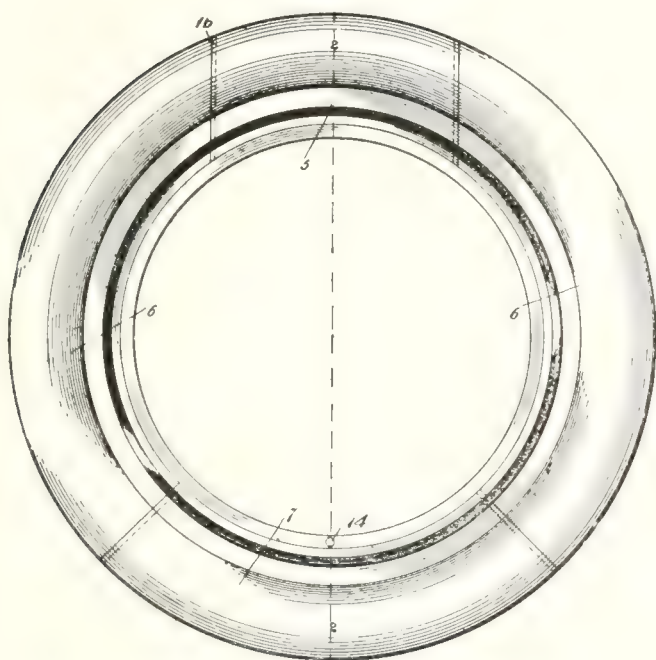
Removable Molding Flask Bar



In a metallic flask bar or plate, there is a body adapted to project into the flask having at its upper edges portions adapted to project over and beyond the side edges of the flask, and means acting between the projecting portions of the sides of the flask for securing the bar to the flask. There is an opening in the part extending over the side of the flask and wedges adapted to be driven through the openings and bear against the outer side face of the flask. The ends of the edges of the body of the bar adjacent to extending part are

provided with projections for engaging the inner face of the flask. The body projecting into the flask has at both ends of the upper edge a part projecting over the top edge of the flask and downwardly outside of it, and provided with teeth and securing means to engage the overhanging edge portions of the bar and the flask walls to force the latter inwardly against the teeth. (U. S. Patent 1,137,851, Nov. 7, 1913. David M. Fahnestock, Pittsburgh, Pa.)

Collapsible Core



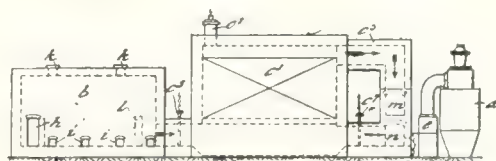
This is a collapsible core with a number of sections forming the core and each having a flange T-shape in cross section, one shoulder of which is undercut. There is a fixed ring adapted to engage the undercut shoulder of the flanges, and an expanding ring to engage the flanges of the sections and force the flanges against the ring, one of the sections having a means of coating with the adjacent sections, so that such may be removed radically without disturbing the other sections when the expanding ring is removed. There is also a split ring adapted to engage the flanges of the sections, a pin to engage the split of the ring for purposes of expansion and forcing the section against the ring. All sections being provided with means for the prevention of lateral displacement of the sections, and one of the said sections having means coating with the adjacent section, so it can be removed radially without disturbing any other sections forming the core when the split ring is removed. (U. S.

Patent 1,136,805, Oct. 19, 1913. Serial No. 794,238. Guy E. Horton and Casper S. Wagner, Akron, Ohio.)

An Alloy-Making Process

This is a process for producing copper containing boron throughout the mass. It consists in fusing calcium fluorid and vitrified boracic acid, adding the copper at a temperature of 2,500° F. or more, and maintaining the copper in molten state until the boron, made by the reaction of the fluorid and acid, is occluded in the copper, then cooling the copper while the fluorid is occluded therein. (U. S. Patent 1,136,909, Nov. 16, 1912. Serial No. 731,863. Edward D. Gleason, New York City, assignor to Neu-Metals & Process Co., New York.)

Copper Smelting Furnace



For a copper smelting plant this is the combination of a non-reversible gas-fired reverberatory furnace, a checker-work regenerator and means embodying an enlarged chamber between the furnace and regenerator so as to be adapted to the removal of dust from the waste gas passing from the furnace to the regenerator at reduced velocity. (U. S. Patent 1,136,834, Jan. 20, 1913. Serial No. 743,159. Walter G. Perkins, London, Eng.)

Method of Coating Metals with Zinc

An improved method of applying zinc coatings has been made the subject of a British patent by the British Thomson-Houston Co., Ltd., London. The articles to be zinc coated are sherardized in the usual manner at a temperature ranging from 350 to 375 degrees Centigrade, the zinc powder used containing from 80 to 92 per cent. of metallic zinc, the remainder being oxide. The success of the operation seems to depend upon keeping the temperature within the narrow limits specified, and this is accomplished by the use of a specially designed furnace, which is heated electrically. The time required to complete the coating varies from 6 to 12 hours. The de-

posit is smooth and of a uniform thickness with a specific gravity ranging from 6.5 to 6.75. The coated articles it is claimed, may be bent, swaged, or otherwise deformed at ordinary temperatures without injury to the coating.

Mott Sand Blast Outfit

The brass foundries have been trying for many years to find a sand blast machine which would fill their requirements and at the same time one which could be purchased at a reasonable price. While there are a



number of machines on the market for this purpose, they are sold at such high prices that the average foundry (and particularly the smaller ones) cannot afford them.

In recognition of the demand for a low-priced sand blast outfit, which would be both thoroughly practical and highly efficient, the Mott Sand Blast Manufacturing Co. have placed on the market the apparatus shown in the accompanying illustrations. This comprises a complete outfit, consisting of pneumatic gun, sand receptacle, two lines

of hose, six nozzles, one hood and one pair of gloves. It is sold at \$50 for the complete outfit, making it the lowest-priced, high-grade apparatus of its kind on the market.

The gun is especially designed and constructed to maintain and use the cyclonic principle of propulsion by air at the highest efficiency possible and is the result of experiments to determine the best form. It is far removed from the usual cheap collection and assembly of pipe fittings, that produce a blasting effect of low efficiency (so common on the market).

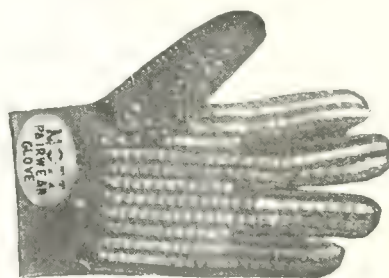
This gun is made with pistol handle, having a trigger to start and stop the blasting operation. By means of this arrangement the blast is always under the instant control of the operator and may be regulated so as to give a blast best adapted for any particular variety of work.

The sand receptacle is designed to produce an even flow of sand of the correct quantity, so essential to the efficiency of a blast.

The sand hose has a 3/16-inch wall of soft rubber encased in a special cotton covering. Soft rubber resists the action of sand more than any other material, and in order to make the destruction of the gun practically impossible the inside is lined with soft rubber, which can be replaced when worn.

The air hose is of standard pneumatic grade, 1/2-inch diameter.

There is no wear on the air nozzles, and air nozzles can be used interchangeably with any size from 1/8 to 3/8 diameter, thus regu-



Glove and Hood

lating the amount of air used and determining the rapidity and grade of the work performed.

The sand nozzles are made of special iron, have long life, and are easily changed.

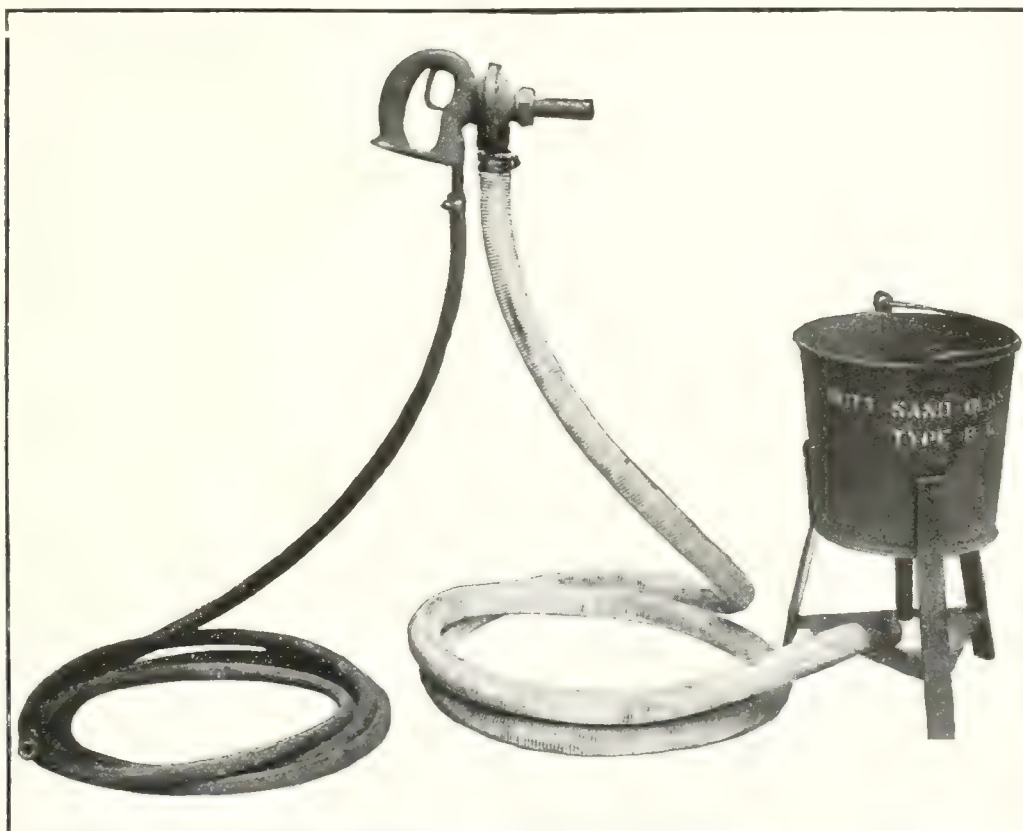
Air for the blast can be taken direct from the line at whatever pressure is available and in a degree can be reduced by use of the trigger, should a softer blast be desired.

This apparatus can be used for sand blasting and cleaning castings made of any material and will quickly pay its entire cost in any foundry where this class of work is to be done. Most foundries recognize the fact that the finish secured by the use of different abrasives with the sand blast add

These are made in three sizes, $1\frac{1}{4}$ ", $1\frac{1}{2}$ " and $1\frac{3}{4}$ " in diameter.

These cupels will be found to be a veritable joy to refiner and assayer. They are not only strong and handable, but the absorption of silver into the cupel is much less than with cupels made from bone ash, when used under similar conditions. They are made of such strength that they will not break in handling, and, in fact, they are just what the assayer has for years wished for. They are packed in lots of 100, 500 and 1,000.

The foreign manufacturing districts where clay and sand crucibles are made are in so deplorable a state at present that it



Mott Pneumatic Sand Blast Gun

greatly to the appearance of the castings by producing a soft matt finish. In some cases castings treated in this way will bring higher prices than when not so treated. The cost of cleaning in any case is greatly reduced, however.

The Mott Sand Blast Co., whose offices are located at 1157 E. 138th St., New York, and 24 S. Clinton St., Chicago, make a specialty of sand-blasting apparatus, and any firms interested in the pneumatic outfit referred to above should write them for a descriptive circular.

Dixon's Wonder Cupels

The Joseph Dixon Crucible Company, Jersey City, N. J., have put on the market what they term "Dixon's Wonder Cupels."

has been a question for some time past if it would be possible for them to fill the demands of our country's laboratories and refiners on these necessary articles, at all.

The Joseph Dixon Crucible Company have now yielded to the repeated urgings from the users of assay crucibles, scorifiers and goods of a like nature, so that at present they have a fairly complete line of this class of goods. So far the sale has not been of so great a volume that they have been able to compete in price with foreign makers, but as scarcity increases and larger orders are secured there is little doubt but that as low, or possibly lower, prices can be made than imported goods of a similar nature now sell at.



The production of articles, especially hollow bodies of tungsten, chromium, or other refractory metals is the subject of a German patent. The powdered metal is mixed to a paste with water, alcohol or other volatile liquid, and this paste is spread over the surfaces of a mold made of clay, plaster or other suitable material. The paste not being liquid, of course cannot be cast but is handled in much the same way as the sand for making cores. The metallic paste within the mold is then heated to a high temperature until sintered together, which is accomplished by leading in wires of the same metal but previously sintered.

Trade Notes

The Central Foundry Supply Co., Columbus, Ohio, have acquired the rights to manufacture the entire line of foundry equipment formerly built by Byram & Co., Detroit. This includes the Colliau cupola, Byram ladles, tumbling mills, turntables, foundry cars, hand-power jib and traveling cranes, core ovens, core oven cars, crucible shanks and tongs, brass melting furnaces, elevators, etc.

The Atlas Brass Mfg. Co., Chicago, has been incorporated with a capital stock of \$10,000 to operate a brass foundry. The incorporators are F. P. Roy, A. M. Roy and B. J. Brahney, 4011 West Van Buren street.

The Standard Plating & Brass Foundry Co., Anderson, Ind., has been incorporated with \$5,000 capital by G. A. Robinson, O. H. Furr and A. H. Gillespie.

Meriden Britannia Company, Ltd., Hamilton, Ont., has been incorporated with a capital of \$400,000 to manufacture articles of silver, nickel, copper, steel, iron and porcelain. The incorporators are George H. Wilcox and George M. Curtis, Meriden, Conn.; William K. George, Toronto; James W. Millard and John G. Gauld, both of Hamilton.

Lange & Landry, Richardson building, Columbia street, Newark, N. J., have started in the casting business and will make a specialty of gold, silver and bronze castings.

The Ansonia Foundry Co., Ansonia, Conn., has been incorporated with \$5,000 capital by William Olderman, Michael Michaelson and others.

Through the efforts largely of the

Chamber of Commerce, Norfolk, Va., the plant of the W. A. Rogers Co., Ltd., at Norfolk, Va., for the manufacture of silver-plated ware, has been taken over by a new company formed with \$30,000 to \$100,000 for its operation. E. C. Hathaway is president of the new concern, which goes by the name of the Hampton Roads Silver Co., and J. M. Williams is vice president.

The Flood City Mfg. Co., Johnstown, Pa. has increased the capacity of its brass foundry by the installation of four melting furnaces.

The Crown Rheostat & Supply Co. has moved to its new location at 15-17 S. Desplaines St., Chicago, where it will carry a full line of plating and polishing supplies and platers' chemicals.

The plant of the Aluminum Castings, Ltd., Ottawa, Ont., has been purchased by the Ontario Specialties, Ltd. This company will specialize in the manufacture of brass, bronze and aluminum castings and particular attention will be given to the requirements of manufacturers demanding a special alloy subject to severe tests and unusual conditions.

An important discovery of tin ore has been made at the Mt. Bischoff Company's tin mine, Tasmania. Sinking shafts have proved the existence of a deposit of alluvial tin ore about 200 yards long, 150 yards wide and 25 feet deep. The ore, is reported to be very rich, nuggets of almost clean oxide having been found rich enough to send directly to the smelters.

The Atlas Brass Mfg. Company, Chicago, has been incorporated with a capital stock of \$10,000 for the operation of a foundry and the finishing of brass castings. The incorporators are B. J. Brahney, 4011 West Van Buren St.; F. P. Roy and A. M. Hoy.

The Coe Brass Company, Torrington, Conn., branch of the American Brass Company, has awarded the contract for two buildings, one for storage, 125 x 200 ft., with saw-tooth roof, the other for coal storage, 50 x 194 ft.

The Smith's Falls Brass & Aluminum Foundry Co., Ltd., Smith's Falls, Ont., Can., has been incorporated with \$60,000 capital to engage in the manufacture of brass, bronze and aluminum castings and other metal specialties. The incorporators are

J. McEwen, J. MacDonald and M. G. Henniger. The new company contemplates the erection of a plant at a cost of approximately \$15,000.

The McCormick Mfg. & Supply Co., Ltd., Welland, Ont., has been incorporated with a capital stock of \$40,000 to engage in the brass foundry business. Frank H. Rice, Melvin Misner, C. L. Cooper and L. A. Glessman are the incorporators.

The Munning-Loeb Co., of Matawan, New Jersey, manufacturers of electro-plating, buffing and polishing machinery and supplies, announces the removal of their New York office from 50 Church St. to the Brion Building, Canal and Sullivan Sts. They also announce that after May 1st, Peter A. Frasse & Co., Inc., 317 to 321 Canal St., New York City will carry a complete stock of Munning-Loeb plating and polishing equipments and supplies, and will act as the Greater New York distributors for the Munning-Loeb Co.

The Miami Brass Foundry Company, Dayton, Ohio, has acquired an additional site adjoining its plant on which it expects to erect a foundry building. Details as to the size of the contemplated addition are not yet available.

Mr. W. R. Abbott is traveling in the interests of James H. Rhodes & Company of New York and Chicago, demonstrating their Carlsruhe Cleanser, and eliminating various troubles and difficulties which the electro-plater encounters in his work. Mr. Abbott has had large and varied experience as a practical and consulting electro-plater. He has been in Philadelphia and Baltimore for the past two weeks and has been very successful in these cities. He will remain in the Eastern territory for six weeks, and if anyone is in difficulty and will communicate with James H. Rhodes & Company, Mr. Abbott will get in touch with them.

The K. & M. Brass & Aluminum Castings Company, Cleveland, has been formed with a capital stock of \$10,000 by D. K. Morgan, E. Denner, John C. Barkley, and others, to operate a brass and aluminum foundry.

G. J. Nikolas & Co., manufacturers of lacquers have moved their Eastern branch from 170 2nd Ave., Brooklyn, to larger and more convenient quarters at 77 Broadway, Brooklyn.

The Miami Brass Foundry Co., Dayton,

O., plans to erect a foundry on a site adjoining its plant which has recently been acquired.

The Metals-Chemicals, Ltd., has been incorporated with a capital of \$1,000,000 to take over the smelting and refining plant of Metals-Chemicals Company, Ltd., Welland, Ont. W. Gilchrist, H. Stewart and V. Hughes, Toronto, are the incorporators.

The Northern Chemical Engineering Laboratories, Madison, Wis., announce the adoption of the shorter name "C. F. Burgess Laboratories." The new name implies no change in management or ownership.

The Lake Erie Smelting & Refining Co., Cleveland, will erect a 2-story addition to its plant to be used for metallurgical and refining purposes.

The Northern Brass Mfg. Company, Waukegan, Ill., has increased its capital stock from \$25,000 to \$75,000.

The Buckeye Aluminum Company, Wooster, Ohio, is erecting a new building, 44 x 44 ft., the first floor to be used as a power plant and the second floor for factory purposes. A gas engine and 400 hp. generator will be installed.

The Buffalo Copper & Brass Rolling Mill, Buffalo, is building a further addition to its plant at Military Road and the New York Central Railroad to operate for the filling of large contracts recently received.

The National Brass Company, Grand Rapids, Mich., will increase its capital stock from \$90,000 to \$200,000, of which \$50,000 will be a preferred issue. The expansion of the company provides for the absorption of the Hardware Supply Company and for the erection of an addition to the present plant, 65 x 150 ft. At a recent meeting of the stockholders W. W. Huelster was elected president, vice Otto G. Kutsche, resigned.

The Chicago Faucet Co., 313 South Clinton street, Chicago, manufacturer of plumbers' supplies, will construct a foundry and machine shop, 50 x 125 feet. The foundry equipment will be purchased in the near future.

Contrary to rumor, the Colonial Silver Company will remain in Portland, Maine, and not remove to Providence, R. I. This on the authority of treasurer F. H. Gabbie. A new site has been purchased on which it will erect a very modern factory, costing about \$15,000.

CLASSIFIED ADVERTISEMENTS

Advertisements for Help Wanted or Situations Wanted published free of charge. Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars. If in display type—two dollars per inch, each insertion.

Help Wanted.

FOREMAN WANTED—Practical plater with at least ten years' experience, to take full charge of plating and tumbling departments of shop producing large quantities of small parts. Most of work is done in barrel plating machines. Man must be capable of producing popular hardware finishes economically. Location eastern Pennsylvania. State references, names of employers during past ten years and salary expected. All information given will be held in confidence. Address "HARDWARE," care of Brass World, Edison Bldg., New York.

WANTED AT ONCE—An experienced plater, one who is thoroughly familiar with electro-galvanizing, brass, gold, nickel and silver plating, also fancy finishes on brass and steel. Must have some cleaning and rolling room experience. In writing, state age and give references. Box No. 1014, Waterbury, Conn.

Situations Wanted.

BRASS and aluminum foundry foreman. Up to date on molding machines and first-class metal mixer for any class of work. Good handler of help; highest references as to ability. Address "METAL MIXER," care of Brass World Publishing Co., Edison Building, New York.

FOREMAN PLATER—Thoroughly experienced and competent on every line of work, except novelties and jewelry. Address "Brooklyn," care The Brass World, Edison Bldg., New York.

PLATER—14 years' experience. Gold, silver, nickel, copper, brass, bronzes, oxidizing, etc.; can fit up plant; make solutions; seeks

steady position in vicinity of New York. For further information address "Reliable," c/o Brass World Publishing Co., Edison Building, N. Y. City.

A BRASS FOUNDRY FOREMAN is open for engagement. Have had 20 years' experience in plumbers' supplies, valve work, builders' hardware and general jobbing. (Reference.) Address "VALVE," care of Brass World, Edison Building, New York.

FOREMAN PLATER or to take charge of polishing and buffing department. Experience in brass, nickel, copper, silver and gold. Address "FOREMAN," care of Brass World Publishing Co., Edison Building, New York.

COMPETENT man, capable of taking charge of plating, polishing, buffing, bright dip and lacquer departments, etc. Fully experienced and can furnish first-class references. Address "MICHIGAN," care Brass World, Edison Bldg., New York.

WANTED—Position as foreman in foundry where experience and knowledge of mixing and melting will be appreciated and paid for in accordance with merit. Position in or near New York City preferred. References will be found satisfactory. Address "BRASS," care The Brass World, Edison Bldg., New York.

Wanted and For Sale.

FOR SALE—Baling Press for putting up all loose material in bales. Brand new and a bargain. Address "BALING PRESS," care Brass World, Edison Bldg., New York.

The Brass World & Platers' Guide

Volume XI
Number 6

New York
June, 1915



A Monthly Journal Devoted to the Art of Refining, Alloying, Casting, Rolling Founding and Electroplating of All the Non-Ferrous Metals and their Alloys

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The A. E. S. Convention

The 3rd Annual Convention of the American Electro-platers' Society which was held this month at Dayton, Ohio, deserves more than ordinary mention. To say that it was a big success from every point of view would be to put it mildly. It was more than that. It may be fairly said to mark a new era, not only in the Society itself, but in the electro-plating industry as a whole.

The Society is of comparatively recent origin and this was only its third annual convention and yet in spite of this the growth and development of the Society in that time has been remarkable. If anyone ever doubted that the A. E. S. was an important factor in the electro-plating industry, such doubts would have been quickly dispelled at the Dayton convention. The most noticeable thing was the great interest which the delegates took in the various papers read and the discussions of these papers and other matters of interest which were a feature of the daily sessions. The paper read by Mr. W. S. Barrows on the Electro-plating with Cobalt attracted particular attention, because the subject presented was what might be termed the latest development in the industry, and one which is attracting considerable attention at this time among many members of the electro-plating fraternity.

The exhibits of plating work produced by members of the Society were also remarkable on account of the great number shown and the variety of beautiful and artistic effects produced. In this respect the exhibits showed a material advance over previous ones. The exhibits of supply houses also far exceeded those of any previous convention, while some of these firms gave practical demonstrations of their products, which served to add considerably to the other interesting features of the convention.

The greatest practical results of the convention will undoubtedly be an increased interest in the work of the national organization and of the various local branches of which it is composed, and, if we were to prophesy along this line, we would say that the men engaged in the electro-plating industry throughout the country, who are not at present members of the Society will realize that in no other way can they advance their own interests so much as by becoming affiliated with one of the local branches

The Supervision of Small Purchases in a Brass Factory

It will be found that almost every factory has a different method of handling requisitions for supplies and many of them are remarkable for their uniform degree of stinginess in the matter of small tools and supplies. We have always noticed a different policy when a larger outlay is concerned and the purchasing agent sometimes doubles the order, or the purchase of a single expensive tool is passed without question.

There are few concerns that carry an adequate supply of small tools in their tool-room to fill the daily needs of their shop force. Too many depend to a very large extent on the fact that many skilled workmen have a considerable tool kit of their own. When a foreman wishes to put an unskilled man on any sort of a common job the poor fellow has to spend much time running around endeavoring to borrow the tools he needs, or to get the foreman to supply him from his own toolbox. The firm does not keep a stock in their tool-room to supply such occasions as this. Such an equipment should be considered just as much a vital part of a modern and up-to-date factory as the lathes, planers or any of the machine tools.

The question is, where should the line be drawn between the requisitions which should be passed for purchase immediately and those which should undergo a closer scrutiny? If the questioning becomes so rigid that a foreman hesitates about asking for things because he always expects to be turned down, many necessary supplies will be neglected. On the other hand, if every request were passed without comment the abuse of the privilege would soon become a source of enormous expense and the shop would be stocked up with a lot of articles it could not find use for.

The disposition of a large share of requisitions can be left to the care of well trained subordinates who should be capable of exercising proper judgment in the matter of standard supplies and minor replacements. Moreover, they should be charged with the exercise of intelligent scrutiny of these orders, so that in case there is an increased consumption due to a poor grade of supply, or to a growing habit of wastefulness, they can take steps to report or correct the trouble.

THE PRESERVATION OF A FAMOUS BELL

By CHARLES VICKERS

The proposition to send the famous old Liberty Bell on another trip, this time to the Panama-Pacific Exposition at San Francisco, has drawn attention to the fact that the original crack has greatly extended and threatens to end eventually in disruption of the bell. There is no reason, however, why such a calamity should be permitted to come to pass, as the bell could be easily put in a condition to withstand the ravages of time for centuries to come.

The metal of which this bell is constructed is the everlasting bronze, an alloy akin to the prehistoric bronzes from which were made the bronze hatchets, arrow heads, urns, and figures that have come down to us from untold ages. Sometimes these relics are recovered, in a remarkable state of preservation from the sea bottom where they have lain since the days of ancient Rome. In Japan, China and India there are numerous bells and statues, some of them of enormous size, and of great antiquity; as for instance the Daiboots at Nara and Kamagura in Japan, and the Great Bell of China, weighing around 120,000 pounds, and so ancient that history fails to record the date of its casting. And in the forests of North Siam, we are told, even at the present time are to be seen figures of the Buddha in large numbers, some of them standing majestically on the sites of ancient temples of which they once formed a part. The temples themselves have centuries ago succumbed to the elements, and now exist as shapeless ruins among the giant forest trees that have since sprung up.

There is abundant evidence, therefore, of the permanent character of bronze whether cast in the form of bells or the softer and more ductile alloy used for statues and other objects.

Composition of Bells

The alloy known as bell metal contains from 18 to 22 per cent. of tin, but bells are

known containing much larger amounts of tin than as stated, although 22 per cent. of tin gives an excellent tone. Bell metal is essentially a brittle alloy, and the more tin it contains the more brittle it will be. The alarm bell at Ziegenhain, we are informed by Brannt, contains 33.59 per cent. of tin and 4.04 per cent. of lead, and this is a bell of a goodly age. The venerated Liberty Bell is not so very old, only 163 years have passed since the first bell arrived from England, and yet it is said to be suffering from the "Disease of Metals" whatever that may be, or it is afflicted with a "Distemper," as we are informed by the non-technical press.

There is no doubt, that a lot of what molders term "bad luck" attended the casting of the bell. The first bell was cast in England and broke the first time it was struck, an accident, that leaves no doubt that it was too high in tin, because the time of testing was August, 1752.

Effect of Cold on Bell Metal

If the test had been made in winter it would not have been so remarkable if it had cracked, especially in zero weather as bell metal is especially brittle at such temperatures. Everyone has noted the cracked locomotive bells in cold weather, though less now than formerly, as the expensive bell metal has been largely superseded by cheaper, less sonorous but stronger metals, consequently the old cracked bell is not now as much in evidence as formerly. At all events the English bell casting was broken up, remelted and recast, with the addition of 10 per cent. of copper to "toughten it." The second bell was cast successfully, but when hung was found to have such a poor tone that the founders, displeased with the criticism to which they were subjected by the townspeople, asked permission to cast it over again. This they eventually accomplished, and to restore the tone added more tin. The results of their labors was the present bell, the tone of which was never

satisfactory, as it was described as a "loud and harsh clamor." This bell when tolling on the occasion of the funeral of Chief Justice John Marshall, cracked, and the crack no doubt has been slowly extending ever since, without drawing attention until it began to extend in a direction at right angles to the original crack, and there is not the slightest doubt that it will continue to extend until the crack entirely encircles the bell at the shoulder, when the lower part of the bell will drop to the floor leaving the crown and shank only, attached to the beam. In its drop to the floor the body of the bell, because of its weight and the crack, will in all probability separate into two or more pieces, after which it will be difficult to piece the venerated old relic together again.

We will assume that the original bell did contain too much tin, that it contained say, 25 per cent. of tin, it would hardly contain as much as the bell of Ziegenhain, for it is presumed that the original founders were experienced men and knew the proper content of tin for such a bell. They must have had some reputation, otherwise they would not have secured the contract, and they may have overreached themselves in their anxiety to get a good toned bell, and have made it a little on the hard side. Therefore if the bell contained 25 per cent. of tin and was remelted with the addition of 10 per cent. of copper, the second bell would contain 22.7 per cent. of tin and 77.3 per cent. of copper, which should have given a bell of excellent tone, and undoubtedly would if the metal had not been oxidized in the melting. This would be very likely to occur, as the records state that Pass and Stow, the founders, were not bell founders by trade. They were probably iron founders, and it is likely they handled the bronze like iron, with the result that the bell was "dead" as far as tone was concerned. This bell was broken up and recast with the addition of more tin, which brought it back to its former brittle state, and insured the certainty of its cracking at a not distant date. The mere fact that this crack has spread though is not to be taken as an indication that the metal "has been attacked by a disease that has been eating into its copper and tin vitals ever since," as some reports have stated. All evidence tends to show that the bell was too hard in the first place, that a lusty stroke of the clapper cracked it and ultimately led us to think

that the metal was afflicted with a "distemper."

Spontaneous Disintegration of Alloys

The disease stories are undoubtedly based on the fact that tin under certain conditions falls to a gray powder, which powder is not an oxide but metallic tin in a different form. It has been found that the cause of such disintegration is extreme cold; also that the same condition can be brought about in the case of block tin by contact with a sample of the gray tin, and owing to this fact the impression prevails that the tin is attacked by a contagious disease or "distemper." It has been found, however, that the gray tin re-

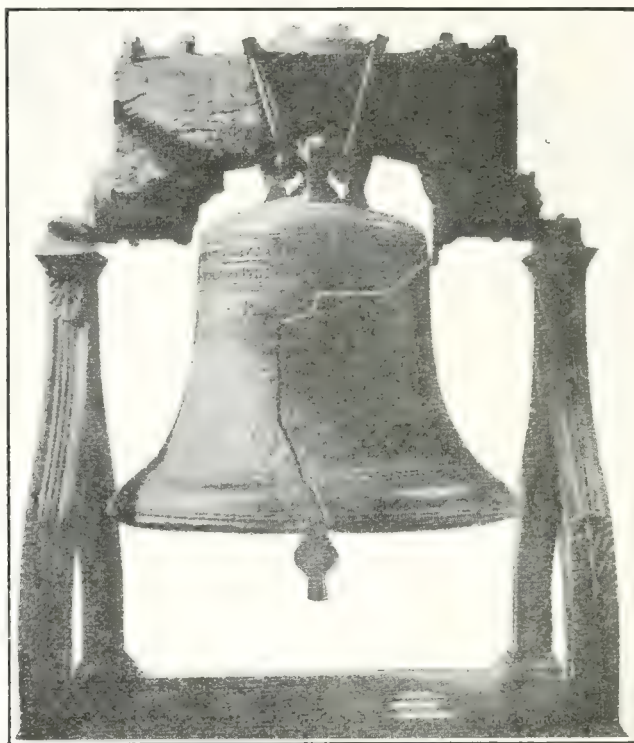


Fig. 1—The Liberty Bell. How Crack Is Extending Shown by Dotted Line.

verts to its normal condition of a solid on being melted, which shows that tin at low temperatures simply loses its power of cohesion. The peculiar property of falling to powder is not confined to tin, as numerous alloys disintegrate spontaneously, notably alloys of nickel and aluminum, alloys of aluminum and titanium, of phosphorus, zinc and manganese, and alloys of calcium, copper and aluminum.

In the case of the last mentioned alloys, disintegration is accompanied by the evolution of gas, the gas being acetylene when calcium is present, and in the case of the phosphorous alloys it is in all probability gaseous phosphine (PH_3). The 50 per cent.

variety of ferro-silicon, also has a tendency to fall apart when exposed to damp air or water with the evolution of large quantities of highly poisonous gases, originated by the presence of such impurities as arsenic and phosphorus in the ferro-silicon. In all these cases decomposition of the metal has taken place, and the change has been brought about by the presence of impurities which have started chemical action resulting in changes such as oxidation, and so forth; the disintegration of tin, however, is not a result of chemical action, as the tin merely changes its form from a solid to a powder, and is a condition brought about by the action of intense cold on the tin crystals which causes them to lose all cohesion and fall apart.

Catalytic Action of Gray Tin

The action of this gray tin upon solid tin is undoubtedly a catalytic one, not a contagious disease, the gray tin acting in a manner analogous to nickel when used as a catalyzer in hydrogenation processes.

In fact this catalytic action of gray tin has been taken advantage of by one inventor who proposes to de-tin tin plate scrap by bringing the tinned surfaces into contact with gray tin combined with a suitable vehicle.

It is a fact well known that copper and zinc alloys are subject to corrosion and crystallization, but this is because the zinc is attacked and dissolved by certain chemical agents with which the brass may come in contact. This difficulty is termed "dezincification," and has been made the subject of much investigation. The crystallization of brass is produced by vibration and is greatly assisted by impurities such as silicon, particularly if the brass is in the path of an electric current, therefore yellow brass trolley ears made ductile by silicon, soon drop the wire. Brass that has been rolled or drawn is also liable to season cracking, that is, the article which may be a tube or a cartridge shell, after standing awhile, splits of its own accord apparently. This is due to strains set up while under the operations of rolling or drawing. This phenomenon has been described and methods for its avoidance pointed out several times in past issues of the BRASS WORLD.

These difficulties occur in the case of brass, an alloy of copper and zinc, but when copper and tin are alloyed to form

bronze, no authentic case of decomposition has ever come to the writer's knowledge. The case of a bell cracking is an entirely different proposition to corrosion, crystallization or season cracking. It is due to the same general cause as the cracking of a china tea cup; it is the result of a force applied to a certain portion of the object, such as a blow, the impact of which the material is not strong enough to resist, or the application of sudden heat which causes unequal expansion, and consequent rupture. There is nothing remarkable, therefore, about the cracking of a hollow body of brittle material, whether it be bell metal or china, and the crack once started is almost sure to increase unless something is done to stop it. Everyone knows how cracks spread in substances liable to such defects, and bells being brittle are cracked with comparative ease; and such accidents have happened frequently in the past as efforts have been made to repair such bells, one of which was to pass a metal saw the length of the crack, cutting away the jagged edges and leaving a smooth cut, the surfaces of which did not touch when the bell vibrated. At the present time, cracks in metals do not cause as much trouble as they did formerly, because they can be welded together again and the object made as strong as it ever was. Such skill has been attained in the use of the high temperature flame that it is well within the bounds of possibility for acetylene welders to repair the Liberty Bell by welding up the crack and make a good job if the sentimental value of the crack was not to be considered.

The sentimental value of the bell far exceeds its intrinsic value, and this sentimental value includes the crack also, as it occurred on an historic occasion—when the bell was tolling the dirge of one of the great men of the Republic—therefore we may be pardoned for believing the crack should remain; although there is no reason why it should be permitted to extend indefinitely.

Restoration of the Liberty Bell

Aside from this, however, the bell could be strengthened very easily without injuring its appearance, and one way that suggests itself is to have bands placed around the inside of the bell, like hoops on a barrel. These bands could be cast of ductile bronze,

using some metal akin to the 88-10-2 alloy. The castings could be made from patterns conforming roughly to the curvature of the inner surfaces of the bell to which they would be fitted, and the band castings could be machined to an accurate fit and then be attached to the bell by means of solder, or machine screws or by both combined. If the bands were sweated in place they would strengthen every part of the bell. One band could be placed around the sound bow inside, another midway of the bell at the waist, and the third at the shoulder of the bell overlapping at the crown and the waist.

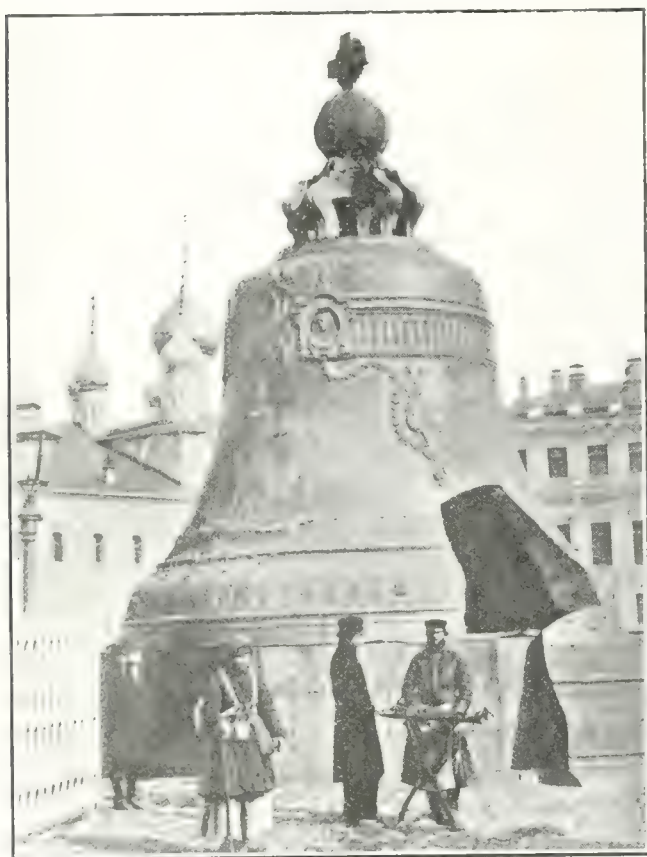


Fig. 2—The Great Bell of Moscow.

Banded in the manner stated it is highly improbable that any further cracks would develop, but if there was any doubt about the matter, the three bands could be connected by longitudinal strips spaced at intervals around the interior of the bell. These metal bands would make a permanent job of the restoration, but they would require some little time in which to be fitted and attached, and in view of the decision to send the bell to California there would not be time to carry out such a method of restoration now, and in all probability the matter will be permitted to rest until its return. There is no question but that if the

bell is carefully packed it will make the trip in perfect safety, as even more delicate objects are continually being transported, but if when being exhibited it is subjected to continual vibration, such as might be imparted by moving machines nearby, there will be considerable danger of the crack extending, in view of which it will be wise to take such precautions as would be likely to reduce this danger to a minimum.

Prevention of Cracking

If the bell is at present hung as shown in the illustration, Fig. 1, the crack is sure to extend because the section underneath the horizontal crack has a certain leverage, which acting together with its weight, will cause the crack to extend upon very little shock or vibration. This could be prevented in large measure by supporting the weight of the bell at the mouth instead of from the crown. The beam and attachments could be left as they are and an ornamental circular platform or pedestal could be built under the mouth of the bell, and being properly supported could be raised by jack screws just sufficient to take most of the weight of the bell, after which small metal lugs or brackets, cast to fit the curvature of the sound bow of the bell could be attached to the platform and bearing against the bell at intervals around its circumference would effectually prevent all possibility of vibration.

It seems quite possible, therefore, for the Liberty Bell to be put in a condition to last for centuries, for if the crack is prevented from spreading, and the bell is strengthened in some manner along the lines outlined, it is difficult to see how it can come to injury, protected as it undoubtedly is when in its usual home. It would also be very nice to be able to ship the bell to various parts of the country for exhibition purposes, whenever the occasion may arise, without any doubts arising as to its ability to withstand the journey without injury; because of its educational value to the rising generations.

There is not the least danger, in the opinion of the writer, of the bell ever disintegrating, even if the metal was oxidized when the bell was cast. Such oxidation would injure the tone of the bell and impair its strength, but would not cause it to fall apart, in fact very few brass or bronze castings are made that are free from oxides, and some of them on being broken up

after their period of usefulness has come to an end, are found to be contaminated with oxide to such a degree that it is a marvel they ever fulfilled their end.

The Great Bell of Moscow

Although tin disintegrates when exposed to low temperatures, when the metal is alloyed with copper there is no such trouble, otherwise the great bell of Moscow would have long since crumbled to dust, as it has been exposed to the intense cold of Russian winters ever since it was cast. A short description of this bell has appeared in a former issue of the BRASS WORLD, but as it is one of the most interesting castings ever made, a few additional particulars may be excused here.

The mold for this enormous casting was commenced in the year 1732 by John Motorin, foundry foreman of the Russian Royal Gun Factory. Associated with him in the work were five men, whose names have come down to us as Cobeloff, Galkin, Cogteff, Scribebriakoff and Loukovnikoff. In January, 1733, nearly 100 workmen were engaged in constructing the mold, the work continuing until November 26, 1734. By this time the mold was ready to cast and was thoroughly dry and secured. The metal was melted in four reverberatory furnaces and amounted to 196,028 pounds for the first charge. The fires were started at 4 p. m., and in the night the metal commenced to melt. The next day, November 26, 189,936 pounds more metal was added, and on November 28, 72,000 more pounds of copper and tin were added and all went well until 11 p. m. of that day, when two of the furnaces gave way, and 234,000 pounds of metal were lost. At 1 p. m. November 29, some old bells were taken from the arsenal and the metal was added to the other furnaces. This charge consisted of some 600 bells, weighing 59,268 pounds, and from the gun factory 148,832 pounds of small copper coin and 10,800 pounds of tin were obtained and charged into the furnaces. This amount of tin being considered insufficient the records state they "sent down town and bought 400 pouds (14,000 pounds) more tin."

Casting the Russian Bell

At 7 in the morning of November 29, the two other furnaces gave way and all the bronze went through the bottom into the

ground, and the heat was so intense the crane took fire, and the entire building was burned down, but the mold was not destroyed although it became wet. In the year 1735 John Motorin died, no doubt from worry and anxiety, and left the work to his son who had been assisting him from the start. The son took up the work with determination to succeed, and on November 23, 1735, the furnaces were ready again, and profiting by the former mishaps, two days later the bell was successfully cast. The inscription on the bell gives 1732 as the date of casting, but merely means that the mold was made in that year. The cost of making the bell outside of the metal was 47,770 dollars, a huge sum in those days.

The dimensions of the bell are: height, 19 feet 3 inches; circumference, 60 feet 9 inches; the thickness of the walls at the thickest part is 24 inches, and at the thinnest part 6 inches. The weight of the bell is 443,790 pounds.

The bell was cleaned in the spring of 1737 and was left in the casting pit, standing on an iron grate, which probably had been the bottom plate in making the mold, and the sides of the casting pit were walled in with logs to prevent the earth from caving in. On May 29, 1737, a terrible fire occurred in Moscow, and the cranes and the building over the bell were burned down. The logs forming the walls of the casting pit took fire creating an intense heat around the bell and the brittle metal cracked in eight places, and one piece seven feet square and 10 tons in weight broke out. This piece is shown in the illustration, Fig. 2, on the ground leaning against the masonry foundation of the bell. The bell thus had a most unfortunate history, but it is doubtful even in these times if we could do any better. "Bad luck," as molders term it, attended this bell from the start, and no wonder no attempt was made to recast it. But one wonders how it would have sounded when hung, and what a mighty blow it would have required to bring out its full tone. The bell is very soft for a bell, and it may have been made purposely so to avoid cracking, as the analysis shows: Copper, 84.51 per cent.; tin, 13.25 per cent.; sulphur, 1.20 per cent.; with traces of silver, zinc and arsenic. With 1.20 per cent. sulphur and low tin, the bell could have no tone, and as a bell was a failure.

After the unfortunate experience of the

fire the bell was left in the ground until March, 1836, so that it was buried when Napoleon reached Moscow and the city was once more given over to the flames. In 1836 the pit was cleaned out and the bell which had been buried for 100 years in the casting pit where it had been created was once more exposed to view. There was considerable delay before the bell was lifted out of the pit which was 30 feet deep, but on July 23, 1836, plenty of ropes being on hand, the work was commenced and in less than 43 minutes the great bell was lifted to the level of the ground for the first time in its history. The bell was moved 40 feet from the casting pit and was placed on a granite foundation, the work being finished on August 4, 1836, nearly 101 years from the day it was cast. The man who made the mold, and the son who cast the bell were long since gone, probably in the belief that their life work had been a failure, but the bell still exists on its foundation of granite, a fitting monument to the memory of John Motorin.

System in the Polishing and Plating Department

By JAMES HASLIP

In order to get the limit of production out of the polishing and plating departments, too much stress can hardly be laid upon the fact that system is necessary in operating these departments.

Cleanliness is one of the most important essentials. Not only as it pertains to the work to be polished and plated, but particularly to equipment of the polishing and plating departments. Every plant should have help whose duties should be to thoroughly clean and overhaul all equipment that has been in use during the day. In the polishing department, all lint, tripoli and other refuse not going into the suction should be gathered up and taken care of, the polishing lathes and blower should be looked after and seen that no bearings are running hot. The glue room should be separate in an especially arranged room, drafts from windows and doors being avoided so that the thin layer of glue will not chill upon application to the wheels.

Glue of any kind should be soaked in cold water several hours before being heated. It being of animal matter is quickly decom-

posed by the heat if soaked in hot water, and its strength impaired. Glue should never be boiled, after being soaked and heated; no further melting is necessary. It should be kept constantly at a temperature not exceeding 160 deg. Fahr.

The glue pots should be thoroughly cleaned before refilling, allowing no scum to accumulate. A number of small pots holding just enough for each day's setting up of wheels, arranged for the different sizes of emery, should be used.

No glue should be used the second day as the strength will be impaired about 50 per cent. by standing over night and thickened glue diluted never has its original strength.

The glueing should be in charge of one responsible person; the time saved by keeping polishers at productive work will be sufficient to pay the glue man. Many polishers each running to the glue pot and fixing the glue to suit himself usually puts the glue in a condition where no one knows its quality.

The emery should be kept in securely tight strong trays wide enough to allow rolling the wheel when setting up. The emery should be warm so as not to chill the thin layer of glue when applying to wheels.

In the plating department the dynamo should be in charge of one person, wiped clean of grease and dust, see that the commutator is not being cut or worn down unevenly and that the brushes are adjusted properly and not sparking. Conducting and anode rods should be bolted and soldered firmly together, and all hooks for copper, brass and galvanizing tanks should be soldered to anode rods. It does not take long for the continual dripping of solutions upon the rods to spoil a good connection. This will save needless hours of cleaning rods and eliminate many of the plater's trouble with poor connections.

Cathode rods and all connections not possible to solder permanently should be watched and dipped bright whenever necessary to insure proper connections.

Square bars for tank connections both for anode and cathode should be used. Place them on a tank so as to rest on the corners, then hooks for anodes and hangers will have more surface and can be made to bind better to the rods.

When anodes are to be cleaned and solutions require stirring it should be done after the day's work; particularly in the case of

nickel solutions standing over night gives them time to settle into normal condition, otherwise the deposit will be sandy and pitted.

Plating Aluminum With Nickel

By J. CANAC and E. TASSILLY*

The difficulty if not the impossibility of depositing an adherent coating of nickel on aluminum is well known. This is not due to a lack of processes, for these are exceedingly numerous (see *Elektrochemische Zeitschrift*, 1912, page 181); most of these are patented; none of them, however, appears to be satisfactory in practice.

In general the deposition of nickel by electrolytic means necessitates a preliminary deposit of some other metal; copper, zinc and iron have been variously recommended as available for this purpose, but despite the more or less ingenious schemes devised to obtain the intermediate deposit of metal, the final nickel coatings obtained have shown anything but the desired degree of adherence. Aluminum thus nickel plated cannot be worked; only pieces already fashioned can be treated and even with these the results obtained are discouraging. However, among recently proposed processes, one patented in France and abroad by J. Canac appears worthy of consideration. This process permits the direct deposition of nickel on aluminum in an adherent form.

The cleansing of the metal consists of the following operations: First, it is passed through a bath of boiling potash; second, it is scrubbed with milk of lime; third, it is soaked in a bath of 2/10 of 1 per cent. of potassium cyanide for several minutes, and fourth, it is subjected to the action of an iron hydrochloric acid bath consisting of 500 parts of hydrochloric acid, 500 parts of water and one part of iron, until the metal takes on a certain appearance best described as a metallic "watering." After each of these operations it is washed in water. The nickel plating proper presents no features of importance so far as the composition of the electrolyte is concerned. The following formula is satisfactory: Water, 1000 cubic centimeters; nickel chloride, 50 grams; boric acid, 20 grams. For depositing the metal there is used a tension of 2½ volts

and a current density of one ampere. The piece of metal coming from the bath has a pleasing soft gray appearance and easily takes on a metallic luster when polished with a wire brush.

Whether the plating be light or heavy, the deposit is always remarkably adherent, far superior to that obtained by other methods; this fact has led the inventor to call the metal "aluminum-nickel," as if it were a true alloy.

Aluminum-nickel will endure hammering; in sheet form it can be bent without cracking and it is only by fracture of the aluminum that the metal is exposed. Aluminum-nickel can be heated without deformation up to the fusing point of aluminum.

It would seem that the peculiar surface which the aluminum has when it issues from the hydrochloric bath gives the nickel an opportunity to deposit itself under conditions especially favorable for rendering it adherent. The result is not at all the same if hydrochloric acid of equal dilution be employed alone. A close examination shows that on the aluminum sheet from the iron-acid bath a light deposit of iron is found.

It is worth while examining the conditions under which this iron deposit forms and the question of its significance as an intermediate deposit of metal. The presence of iron on the aluminum can be easily ascertained with a Curie and Chéneveau magnetic balance. On comparing the aluminum cleaned in potash with that afterward treated in the iron-hydrochloric bath, the ratio of magnetic attractions is found to be 14. The magnetic balance being an extremely sensitive instrument, the quantity of iron thus indicated is necessarily very small. To confirm this, the iron has been estimated with a Féry spectrophotometer, using the method of E. Tassilly. The quantity of iron distributed over the aluminum was found to vary from ¼ to ½ gram per square meter. The significance of the iron deposit as a continuous intermediate layer is thus negligible.

On the other hand, an examination of the metal cleaned in the iron-acid bath, using the Chatelier microscope, shows the surface full of minute cavities; in these the nickel proceeds to deposit in the process of electrolysis. It appears that the iron forms a network on the surface of the aluminum and develops a multitude of couples, which assist the hydrochloric acid to attack the

*Bulletin de la Société d'Encouragement pour L'Industrie Nationale.

aluminum at certain points, action being set up more or less energetic according to its proximity to the iron, which thus acts rather as an excitant. The result of this is that peculiar aspect of the aluminum surface, particularly adapted for anchoring an electrolytic deposit. Under these conditions the nickel is so deposited as to be "rooted" in the aluminum and forms so perfect a bond with it that whatever the thickness of the deposit it is impossible to detach the nickel without tearing off particles of aluminum.

Gold-Platinum-Palladium Deposit in Southern Nevada

Residue From Copper Mine Yields Precious Metals in Commercial Quantities.

Platinum and its closely allied metals palladium, iridium, and others are among the few mineral products for which the United States is dependent on foreign countries. Platinum is indispensable to the chemist, and in recent years it has also come into vogue in the manufacture of jewelry. It is extensively used for chains and for the setting of diamonds, the claim being made that the platinum, besides being more resistant than silver and harder than gold, sets off the diamonds more effectively. Palladium resembles platinum but has a higher luster, like that of silver, and is used as an alloy with platinum to give this metal increased brilliance and for other technical purposes. The demand for palladium is considerably greater than the supply, and in the last few years the price of platinum and palladium has been double that of gold.

It is therefore of interest to learn that platinum and palladium have been found in ores of the Yellow Pine mining district, in Clark County, Nev. The principal find was made at the Boss mine, which is described in Bulletin 620-A, recently issued by the United States Geological Survey. The ore deposit on the Boss claim was discovered some 30 years ago, having been located for copper, the presence of which is plainly indicated by chrysocolla and other oxidized copper minerals. In the nineties a leaching plant was built at Goodsprings, 12 miles from the mine, and an attempt was made to treat the oxidized copper ore, but the process proved a failure. Not until recently was the gold and platinum content of the ore recognized. The failure to recognize, or

at least fully to appreciate, the gold-bearing character of the ore seems to have been due to the fact that much of the gold is very finely divided and can not be obtained by panning, and also to the fact that some of the extraordinarily rich material when panned yields a black residue that might easily be and probably was thrown away as worthless black sand. Systematic sampling of the deposit early in 1914 led to full recognition that gold is present in valuable amount, and it was during the course of this sampling that the platinum and palladium content of the ore was discovered.

The deposit consists of a mass of fine-grained quartz inclosed in dolomites of Carboniferous age. The precious metals are especially associated with a rare mineral that is known by the rather unwieldy name plumbojarosite; it is a hydrous sulphate of iron and lead. The mineral is locally known as greenish talc, and this name accurately describes its main physical properties; pockets of the pure mineral carry 100 ounces or more of platinum and palladium and several hundred ounces of gold to the ton. This exceeding richness points to a concentration of the precious metals in the oxidized ore by surface solutions, so that in depth the pockets of extremely high grade ore, such as are now being extracted, will give place to ore of moderate grade.

A copy of the report, which is entitled "A gold-platinum-palladium lode in southern Nevada," by Adolph Knopf, may be obtained free on application to the Director of the Geological Survey, Washington, D. C.

Price of Lead

It is really remarkable that the price of lead has not been affected by the war as this metal constitutes 88 per cent. of the alloy of which bullets are composed. The other constituent is antimony and is present usually to the amount of 12 per cent., although there is some variation. Antimony has been greatly affected and brands such as Hallett's and Cookson's which are largely used in making babbitts are now almost equal to tin in price, although in antebellum days they were pretty steady around 10 cents per pound.

The Hazel Atlas Glass Co. of Wheeling say, "We find this little magazine very helpful in our plating work."

Brinell Hardness Testing of Non-Ferrous Alloys

By V. SKILLMAN*

Among the more important physical tests to which non-ferrous alloys are submitted there is one which, until recently, has received comparatively little commercial application. Although the hardness of a metal is often of considerable importance to both the manufacturer and engineer, it usually is classified by stating that it is hard or soft without reference to any definite method of measuring that quality. Naturally, the result depends largely upon the personal view of the observer. If the machinist classifies an alloy as hard, the engineer will quite likely find its resistance to compression or indentation is not such as would lead him to call it hard.

Considerable of the confusion is the result of the difficulty in defining hardness. It seems at present impossible to use any scientific unit to express hardness and quite different meanings are embraced by the one general term. As the result of such a condition the methods devised for measuring hardness have been the outgrowths of attempts to obtain data with some particular idea in view in each case. The numerals found are, therefore, empirical and depend upon the method used in their determination.

Hardness Tested by Scratching

One of the oldest methods of determining hardness is to ascertain the amount of resistance to scratching. This is the method of the mineralogists. Means have also been devised for its application to metals.

Other methods measure the compressive hardness by determining the resistance offered to indentation by another body. A measurement of the elasticity is made use of in some methods, while in others toughness and abrasive qualities are brought into prominence in determining the cutting hardness.

Of the many methods developed, several

have lately come into prominence on account of the possibility of their commercial application. One of these used extensively is that devised by Brinell. It is dependent upon the resistance offered by the sample to indentation. The test consists of pressing a hardened steel ball into the surface of the sample being investigated, by means of a definite load and measuring the diameter of the resulting indentation. The hardness numeral is the ratio of the pressure on the sphere to the area of the spherical indentation.

The test can be made in any form of apparatus capable of pressing the ball upon the surface of the metal and measuring the pressure exerted. In the absence of a special piece of apparatus the test may be made with considerable accuracy in the average small size tension-compression testing machine. The machine is arranged as for a compression test, and the steel ball is fastened to the under side of the pulling head as near the center as possible. It is better if it is not fastened to hardened steel, as it will more readily form a seat for itself when making the first impression. No elaborate device is necessary to hold the ball if the specimens to be tested are mounted fairly level, as they should be. A piece of tar or similar material is all that is required to hold the ball in place.

The test is best made by first bringing the ball just in contact with the face of the specimen. The weight on the machine is then run out to a hundred pounds or so less than the load finally desired. Pressure is next applied until the beam floats, using one of the higher loading speeds. The weight is quickly advanced and set accurately at the full load to be applied. The slow speed of the machine is then used to float the beam and keep it floating during the time required for the test.

It probably is sufficiently accurate to figure the time which the piece is subjected to pressure as beginning when the beam

*From a paper presented at the Chicago, 1914, convention of the American Foundrymen's Association.

first rises, as the greater part of the load is then operative. After 30 seconds, or 15 seconds if the 3,000 kilogram load is being used, the pressure is released and the diameter of the indentation measured in millimeters.

It has been found that after a little practice with a fairly sensitive testing machine results can be obtained which check very well with determinations made on Swedish apparatus.

Standard Methods

In making the Brinell test it is exceedingly important that what may be recognized as a standard set of conditions be followed. Most of the data so far published has referred to ferrous material. Much of that which has been obtained on non-ferrous alloys would often have been of more general value and application if the conditions suggested by Brinell had been followed in making the tests.

It has been recommended that a standard ball of 10 millimeter diameter be used with loads of 3,000 kilograms for ferrous materials and 500 kilograms for non-ferrous alloys. It also is advisable that iron and steel samples be submitted to the pressure for 15 seconds and alloys for about 30 seconds. The factor which has the greatest influence on the numeral obtained is the pressure applied. It has been found that elastic deformation of the sphere used is produced by the load. It is relatively greatest at the lowest pressures. Under such loads the indentation is small and the resistance offered is all in the direct line of the pressure applied. There is practically no lateral component tending to make the sphere retain its shape as when heavier loads are applied and the indentation is likely to be greater.

If the depth rather than the diameter of the indentation produced were measured, the size of the load would not be of as much consequence. It is quite likely that a linear relation exists between depth of indentation and load. It is, however, more difficult to measure the depth than the diameter of the indentation, and the latter is now almost exclusively the measurement made in commercial work.

Under all conditions the radius of curvature of the indentation is greater than the radius of the sphere. The amount varies, however, depending upon the alloy.

Table I gives the results of tests made

with two different loads, each pair of determinations being made on the same sample. The hardness number was determined by reading the diameter of the impressions.

The figures in Table I illustrate the necessity of either following adopted standard methods of testing or stating the conditions under which the test was made and especially the load applied.

Diameter of Ball

The diameter of the ball used does not seem to affect the test greatly, nor does a variation in the length of time the load is applied. It would seem preferable, however, especially in the absence of more detailed information concerning their effect on the test as applied to non-ferrous alloys, to follow standard methods.

Judging from the similarity of the compression and Brinell tests, it would appear that the length of time the load is applied would have some little influence on soft materials such as white metals and babbits, which are inclined to flow under com-

TABLE I.
HARDNESS NUMERALS OBTAINED WITH DIFFERENT PRESSURES.

Alloy.	How cast.	Hardness under	
		500 kg. load.	3,000 kg. load.
Phosphor Bronze, 10 Sn	Chill	86	107
Phosphor Bronze, 20 Sn	Sand	158	196
Phosphor Bronze, 10 Sn, 10 Pb	Sand	50	69
Phosphor Bronze, 10 Sn, 10 Pb	Chill	80	103
Gun Bronze, 10 Sn, 2 Zn	Sand	70	82
Gun Bronze, 10 Sn, 2 Zn	Chill	86	107
Manganese Bronze...	Sand	109	137
Manganese Bronze...	Chill	119	143

pression. It almost surely would if the load were applied for five minutes as directed in one recently published handbook, which gives directions for making the Brinell test.

Besides the variables due to the manner of testing, there are also those introduced by the sample. The effect of casting conditions upon the tensile strengths of alloys is becoming quite well known. The hardness is effected by many of the same factors.

One of the most noticeable influences is the diminution of grain size due to chilling or to *skin effect*, with a resulting increase in hardness. A large casting of red brass showed a hardness of 43 to 48 when tested inside a heavy section. The skin on a sec-

tion 1/4-inch thick, of the same casting, had a hardness of 70 to 80.

Chilling Phosphor Bronzes

As in the tensile test, chilling seems to have the most influence on the hardness in the phosphor bronzes. These same alloys are decidedly influenced by the temperature of pouring and the resulting rapidity of solidification. A phosphor bronze containing 20 per cent. tin gave a Brinell hardness of 100 to 109 when poured hot. The same pattern of test piece poured cold from the same pot of metal gave 158. Compression tests showed a permanent set of 0.070-inch per inch under a load of 100,000 pounds per square inch for the hot-poured material and 0.024-inch per inch for the cold-poured. Test bars cast in size and pulled without machining gave 23,800 pounds per square inch tensile strength for the former and 35,000 pounds per square inch for the latter. The Brinell test offers an excellent means of judging the quality of such material without going to the trouble of making compressive or tensile tests.

It is evident that the hardness of a certain alloy cannot always be expressed by one definite Brinell numeral. The best that can be said is that it usually has a hardness between certain limits depending much on the particular sample selected for test. It would be well if some standard form of test specimen could be agreed upon. The end of the cast-to-shape test bar has been found convenient by the author for comparative work.

Some idea of the hardness of a few common brass foundry alloys may be obtained from Table II. The determinations were made with a 10 millimeter ball and a pressure of 500 kilograms applied for 30 seconds. The sand cast data were obtained by using the ends of cast-to-shape test bars, and the chill cast data are from sections of small ingots cast in an iron mold.

The relation between Brinell and scleroscope hardness determinations would often prove useful if it could be fairly accurately determined. It is at times stated that to change from the Brinell number to the scleroscope reading, the former should be divided by six, and the scleroscope number multiplied by six gives approximately the Brinell numeral.

Such directions may hold for ferrous material where loads of 3,000 kilograms

have been used for the Brinell tests and the universal hammer was used with the scleroscope. They do not hold, however, for non-ferrous alloys tested under 500 kilogram loads and with the magnifier hammer in the scleroscope. Further, it does not seem likely that any one factor will be found to apply for all classes of non-ferrous alloys.

The hardness test is capable of consid-

TABLE II. UNUSUAL HARDNESS OF SOME COMMON ALLOYS.		
Alloy	Hardness under 500 kg. cast in	
	sand.	chill.
Phosphor bronze, Cu 90, Sn 10	67-70	93-100
Phosphor bronze, Cu 80, Sn 20	143-158	.....
Phosphor bronze, Cu 80, Sn 10, Pb 10.....	65-70	80-89
Gun bronze, Cu 88, Sn 10, Zn 2.....	65-74	86-93
Composition, Cu 85, Sn 5, Pb 5, Zn 5.....	48-59	63-67
Yellow brass, Cu 69, Sn 1, Zn 30.....	54-59	59-65
White brass, Sn 66.5, Zn 29, Cu 4.5.....	19-20	22-23
S. A. E. Babbitt, Sn 84, Sb 9, Cu 7.....	.....	26.5-30.5
Manganese bronze.....	109-119	124-130

erably wider commercial application than it has so far received. Much useful information can be quickly gained by its aid, but in order to avoid confusion and possibly self-deception, it is necessary to be familiar with the more important conditions which influence the results.

A method of producing transparent objects, such as ornaments, etc., from gelatin employs an aqueous solution of 100 parts of gelatin, 3 parts of potassium sulphate, 4 parts of borax, 3 to 4 parts of common salt, 2 parts of potassium bichromate, 3 parts of magnesium sulphate and sufficient coloring matter to give it the color required. This mixture is concentrated on a water bath until viscid, when it is cast into molds of the required shapes. After the molded objects are cooled they are lacquered.

Dr. G. D. Bengough, M. A., honorary investigator to the corrosion committee of the British Institute of Metals, being absent on active service, W. G. Gibbs, M. Sc., has been appointed to his place. Mr. Gibbs, prior to the outbreak of the war, was acting as Dr. Bengough's assistant in connection with the work of the corrosion committee. He is now engaged in a series of important investigations to be embodied in the third report to the corrosion committee, which will probably be presented at the forthcoming autumn meeting of the Institute of Metals.

QUESTIONS AND ANSWERS

All communications under this head should be addressed to the "Questions and Answers Editor"

Will it Pay to Put in a Foundry?

QUESTION No. 27.—We use a large number of brass castings ranging in weight from one-fourth pound to six pounds and have hitherto procured them from outside parties, but lately it has occurred to us that there might be some advantage in putting in a foundry of our own. Our requirements last year covered between 10 or 12 tons of these castings, and we would be glad to have your opinion in regard to this matter.

ANSWER.—Unless there are other considerations than cost, we doubt whether you would be justified in fitting up a brass foundry to do the work yourselves. An output of 300 pounds of castings per molder per day is usually figured as necessary to place a foundry on a paying basis when the entire business is that of making castings. As a department of an established business in other lines, and blessed with a light overhead, a brass foundry can be made to save money for its owners on an output of 100 pounds of castings per molder per day, provided the output per month is not less than 10,000 pounds of good castings. It is difficult to run any sort of a foundry with less than three men, though one of the "men" may be a boy. A skilled man will be required for a foreman, and he will cost at least \$100 per month, and if his output is 2000 pounds per month the labor cost for the foreman alone is 5 cents per pound of castings. Add to this the cost of the helpers, fuel, crucibles, loss and percentage of overhead. Figure that it is doubtful if one man can turn out 500 pounds of light castings per week and make his own cores, melt his own metal and do the many other chores that crop up and it will be easily seen that 10 cents per pound over the cost of the metals would be the best that could be expected. When everything is figured there is no doubt the castings would cost more than to purchase them in the open market.

Trouble From Porous Castings

QUESTION No. 28.—We have had consider-

able trouble from porous castings lately and have wondered whether it is due to oxide or from the metal absorbing oxygen while in the furnace. A great deal of our small work is made from the chips and scrap from the larger castings, but have also had trouble with the large castings, such as plungers. We use ingot metal supposed to consist of copper, 85 per cent.; tin, 5 per cent.; lead, 5 per cent., and zinc, 5 per cent.

ANSWER.—The trouble is due to oxidized metal and may be caused by your method of melting same, or be inherent in the ingot. Make a few heats of new metal of the same composition, melting and handling the metal in the same manner as practiced with the ingot, and if the new metal castings come sound and free from defects it is evident the ingots are at fault. Then you can take it up with the makers. In melting either ingot or copper, use sufficient charcoal to well cover the metal while in the furnace, and in case the same difficulty is experienced with the new metals as with the ingot, add 6 ounces of 15 per cent. phosphor-copper per 100 pounds of metal just previous to removing it from the fire and stir well.

Black Finish on Steel

QUESTION No. 29.—We have quantities of work similar to enclosed samples on to which we want to put a good black finish, something we can put directly on to the steel at a reasonable expense. We do not want to use the saltpeter process. We also enclose a small piece of a buckle with a very nice black finish. Can you tell us how this is done?

ANSWER.—We don't know of any process aside from the saltpeter process. The small buckle has been treated with the saltpeter process.

Formula For New Alloy Wanted

QUESTION No. 30.—Can you give us the formula of a new alloy that is being used for refrigerator hardware? This metal when finished has the appearance of nickel

plate on brass, and the castings look like white metal. The base of the alloy is iron and we are informed that it will not rust.

ANSWER.—In the absence of a sample of the alloy in question we shall be obliged to hazard a guess as to its composition. The following alloy has been proposed for refrigerator hardware and other castings, but we are unable to state just how successful it may have been. The alloy is composed of iron, 52 per cent.; copper, 26 per cent.; nickel, 18 per cent.; aluminum, 4 per cent.

Scrap Brass Castings

QUESTION No. 31.—It has been our custom to make our brass castings from all new metals, but owing to the present high prices we have been thinking of using some scrap brass and would like to be informed how to use it to the best advantage. The castings are used in connection with hydraulic work and must have a close grain and be able to withstand a pressure of at least 100 pounds. How can we clarify and purify the metal? Also would you advise remelting the scrap into ingots before using, or could just as good results be obtained by putting in the scrap with new metal and melting together? We have been advised to use both phosphor-tin and phosphor-copper; is there anything better, and which would cause the greater shrinkage of the metal?

ANSWER.—If the castings are high grade the scrap used herewith must be high grade; in other words, nothing but clean scrap the approximate composition of which is known can be used. It would not be practical to purchase miscellaneous scrap and melt it down into ingots, as it would then cost as much as new metal. But if the scrap brass is good machinery scrap it can be used to advantage. If a considerable percentage of the heat is scrap, charge the latter with the copper of the new metal to be added, otherwise melt the copper first, add the mixture, then whatever scrap is required. Use plenty of charcoal for a cover when melting. Either phosphor-copper or phosphor-tin can be used with exactly the same results. In the case of phosphor-tin use 1 per cent. containing 5 per cent. phosphorus, and of phosphor-copper one-third pound containing 15 per cent. phosphorus. For composition metals there are better deoxidizers than phosphorus, but they require more skill in their use. Phosphorus does not cause excessive shrinkage.

Coloring Gold Jewelry

QUESTION No. 32.—In coloring gold jewelry we have some trouble when we wish to color only part of the same and not to color other parts.

Will you kindly let us know what we can cover the parts with that we do not wish to color? We have tried shellac and we find that the cyanide solution when it is warm cuts the shellac right off.

ANSWER.—Any dealer in plating supplies can furnish a cyanide "stopping off" varnish that is quick drying and satisfactory. These we believe would probably be better than any you could make yourself. However, the following formula may help you:

Rosin	10 parts.
Sealing wax.....	4 parts.
Fine polishing rouge.....	3 parts.
Beeswax	6 parts.

Formula for Combination Metal

QUESTION No. 33.—We would like to obtain a formula for a combination metal suitable to use in connection with ammonia. This formula must not contain either copper or zinc and must be reasonable in price.

ANSWER.—The exclusion of copper makes it difficult to obtain any alloy that will fill the requirements and be reasonable in price. Pure nickel or alloys containing nickel are used for caustic alkalis, but are quite expensive. If a lead-antimony alloy cannot be used it will be necessary to fall back upon iron or steel.

Trouble With Solutions

QUESTION No. 34.—My solutions work right on brass, but my tinware rubs off on certain parts like flour. Solution test is 5½. My tinware turns dark as it comes out of solutions. Kindly advise me as soon as possible.

ANSWER.—Add 1 ounce phosphor-tin to every 100 pounds of tin.

Density of Solution Wanted

QUESTION No. 35.—In April issue of the BRASS WORLD I note the following nickel solution:

Water	1 gal.
Double nickel salt.....	8 oz.
Single nickel salt.....	1 oz.
Sal ammoniac.....	1 oz.
Boracic acid.....	6 oz.

In this connection please advise me what density the solution should be in order to

obtain satisfactory results, and in addition, which salt should be added when the solution reaches its minimum value.

ANSWER.—The solution made up to this formula will have a gravity of 1.050 or 5° Baumé. Regarding second question, would say substitute both salts in same ratio as formula.

Coloring Formula

QUESTION No. 36.—Would you kindly assist me to a coloring formula for tempered polished steel that will render a bright, iridescent blue (about navy in depth of color) without heat? Would this color require electricity for depositing?

ANSWER.—Use 14 drachms of litharge and 3½ ounces of caustic potash and 1 quart of water. Boil for one-half hour. Suspend the articles carefully cleaned and pickled to the anode rods and with a weak current introduce in the lead solution a platinum wire without touching the articles. Several colors will appear and when the iridescent blue appears, remove, wash and finish as usual.

Black Nickeling

QUESTION No. 37.—Kindly give us recipe for the cheapest process of black nickeling sheet zinc.

ANSWER.—

Double nickel sulphate..... 8 oz.
Ammonium sulphocyanate.. 2 oz.
Zinc sulphate 1 oz.
Water 1 gal.

Use 1 volt.

Deposit of Nickel on Aluminum

QUESTION No. 38.—The problem of obtaining a satisfactory deposit of nickel on aluminum has recently been presented in our business. Going through our file of your magazine, we find an article on page 175, volume 10, number 5, referring to this subject, which seems of particular interest. You will note that the writer of this article refers to his discovery of an amalgam, the use of which on aluminum overcomes the difficulty ordinarily encountered in the electro-deposition of other metals thereon. Please furnish us with any particulars you have regarding this process and advise from what source fuller information may be obtained. It is also possible that you may have some information in regard to this

problem along other lines which might be of assistance, in which case we shall be very glad to have your advice.

ANSWER.—Writer is unable to obtain at this writing a copy of BRASS WORLD to which you refer. However, he can say that the following account seems quite practical and worthy of a trial, although he has not as yet tried it out himself:

Nickel plated aluminum. *Iron Age*, April 15, 1915.

"A successful nickel plate of aluminum is announced by M. Le Chatelier in a recent communication to the Académie des Sciences. This has not been accomplished heretofore by ordinary methods. The new process consists in a preliminary scouring of the aluminum in a bath of hydrochloric containing a certain portion of iron. The iron is precipitated on the surface of the aluminum, forming a kind of network. When this is passed into a nickel bath the nickel becomes entangled in this network and adheres strongly to the aluminum. This process is based on a physical action and appears to solve the problem hitherto considered impossible."

Coloring Solution

QUESTION No. 39.—Kindly give us what you consider your best formula for a guinea gold coloring solution, or give us the date on which such a formula was published in the BRASS WORLD, as we have nearly all of the back numbers of the magazine which have been published.

ANSWER.—

Water 1 qt.
Gold chloride.....27 grs.
Potassium cyanide.....26 oz.
Use cold. Use about .15 amp. and 2 volts.

Cleaning Low and High Brass

QUESTION No. 40.—What are the best methods for cleaning low and high brass wire on coarse sizes? We are treating these metals as follows: Taking the wire direct from the annealers and dipping into a tank of cold water. Is this treatment good for the metals? Is there a better method? Also what acids should be used?

ANSWER.—You can use an acid for the purpose composed as follows:

One part commercial nitric, strong.
One part commercial sulphuric, strong.
Four parts water.

You can avoid the process entirely by annealing in air-tight drums and allowing the wire to cool off in the drums before opening.

Turning Brass Dead Black

QUESTION NO. 41.—Do you know of a dark colored metal or of any way to turn brass or copper a dead black? We do not mean to finish the surface that way, but is there any material that can be mixed in through the metal that will not wear off. This metal must also be soft enough for drawing. We would appreciate any advice you can give us on this.

ANSWER.—It is impossible to add anything to metal to change the color except on the surface.

Solutions

QUESTION NO. 42.—1. How to make successful brass solution.

2. How to make a first-class copper solution for galvano work.

3. How to make a good cyanide copper solution.

4. Would you advise plating plaster of Paris figures in cyanide copper solution or in galvano solution?

5. Do you think a 6-volt and 75-ampere dynamo strong enough for a 60-gallon tank?

ANSWER.—

1. Water 10 qt.
Carb. of soda..... 10½ oz.
Bisulphate of soda..... 7 oz.
Copper cyanide..... 3½ oz.
Zinc cyanide..... 3½ oz.
2. Water 1 gal.
Copper sulphate..... 1 oz.
Sulphuric acid..... 1 oz.
3. Water 10 qt.
Carb. of soda..... 8½ oz.
Bisulphite of soda..... 7 oz.
Acetate of copper..... 7 oz.
Pot. cyanide..... 8½ oz.
4. Use cyanide.
5. Yes.

Use of Pitch With Cyanide of Copper

QUESTION NO. 43.—We have seen it stated several times that when using a cyanide bath of any description it is advisable to avoid the use of pitch as a lining, but we have never seen any reason given for this so would be obliged if you could enlighten us.

We have a bronze bath 8 ft. long, 4 ft. deep and 2 ft. wide, with soft rolled copper

anodes (sheet), total area per side of work 36 sq. ft., the bath being made up with copper and zinc carbonates, sodium bisulphite and potassium cyanide. This tank gives good results for a time, but after a week's fairly heavy working more copper carbonate has to be added, as the tank runs to brass.

The anode surface has always been in excess of that of the work, so the chance of stripping the bath we think unlikely and the peculiar thing is that if sodium bisulphite is added in sufficient quantities (1 oz. to the gallon) it runs a perfect copper for a day or so.

At present we are getting a fine brass but the anodes rapidly coat over with a thick white film and we are considering the advisability of throwing the solution away and making fresh with the metallic cyanides, but would like your opinion first.

ANSWER.—There is a chemical action which takes place which prevents the use of pitch with cyanide of copper. Would suggest that you try the following formula:

Water	10 qt.
Carb. of soda.....	10½ oz.
Bisulphite of soda.....	7 oz.
Copper cyanide.....	3½ oz.
Zinc cyanide.....	3½ oz.
Potassium cyanide to clear.	

White Bronze

QUESTION NO. 44.—Please give all the information that you can in regard to white bronze, especially such as used by the Bronze Monumental Company, New York. I have never seen any monuments made of this metal and in fact I don't think there have been any placed in this State.

It is claimed that white bronze is the trade name for refined and purified zinc and monuments made of it are finished with sand blast and are light gray in color, said to be beautiful and more permanent than granite.

Please say what satisfaction it has given for monumental purposes.

ANSWER.—You seem to possess about all the information on this subject that is possible to give. The monuments are zinc and sand blasted and give a pleasing finish and are quite generally used. If we can do anything further for you will be glad to do so.

O. J. Holt, Chelsea, Mass., writes "I have taken the BRASS WORLD since the first number, and should miss it."

THIRD ANNUAL CONVENTION AMERICAN ELECTRO-PLATERS' SOCIETY

Dayton, Ohio, June 3-4-5. Headquarters, Hotel Algonquin
Next Year, Toronto, Canada

The new officers—President, W. S. BARROWS, Toronto; 1st Vice-President, H. H. WILLIAMS, St. Louis; 2nd Vice-President, W. G. STRATTON, Bridgeport, Conn.; Secretary-Treasurer, W. FRAINE, Dayton; Editor J. H. HANSJOSTEN, Kokomo, Ind.

The Proceedings

The third annual convention of the American Electro-Platers' Society convened in the Hall of Industrial Education of the National Cash Register Company's factory, Dayton, Ohio, June 3d, 1915, at 10:00 a. m. More than two hundred were in attendance.

The convention was called to order by President Joseph H. Hansjosten, the following officers being present: President, J. H. Hansjosten; first vice-president, W. S. Barrows; second vice-president, H. H. Williams; secretary, W. Fraine; editor, H. E. Willmore. Mr. J. E. Sterling, treasurer, arrived in time for the closing session Saturday.

Vice-President Williams, as secretary of the Executive Board, submitted the report of the Credentials Committee, which was approved by the convention. President Hansjosten turned the morning session over to the Dayton Branch and introduced Secretary Fraine as president of the Dayton Branch, who on behalf of the branch, extended a cordial welcome to the delegates and visitors and then introduced President Hansjosten, who responded, thanking Dayton Branch for the hospitality extended and promised. Mr. Fraine introduced Mr. H. M. Waite, Dayton City Manager, who welcomed the convention on behalf of the city, and Mr. J. M. Switzer, supervisor of the office division of the N. C. R. Co., who extended a welcome on behalf of that company. The rest of the morning session was taken up by addresses of vice-presidents, introductions of delegates and visitors.

The afternoon session was called to order at 2:00 p. m. and was taken up by reports of officers, discussions of amendments and general business. Friday morning's session was devoted to clearing up unfinished business and new business. Friday afternoon was given over to election of officers for the ensuing year and choosing the 1916 convention city.

The following were elected: President, W. S. Barrows, Toronto, Can.; first vice-president, H. H. Williams, St. Louis, Mo.; second vice-president, W. G. Stratton, Bridgeport, Conn.; secretary-treasurer, W. Fraine, Dayton, Ohio; editor, Jos. H. Hansjosten. Toronto was selected as the convention city for 1916. A short session was held at the Algonquin Hotel Saturday afternoon to hear the report of the Supreme Treasurer, who arrived Saturday morning.

Evening Sessions

The evening sessions were held at the Algonquin Hotel Thursday and Friday evenings, and the following papers were there read and discussed: Commercial Aspect of Electroplating with Cobalt, W. S. Barrows, Toronto; The Metric System, F. A. Shepherd, Buffalo; Tin Plating, J. H. TerDoest, Akron, Ohio; Cobalt Plating, Mr. Dabold, New York City; Historical Review of the Electro Deposition of Copper, read by G. B. Hogaboom, for the Newark Branch; Some Experiments with Grain Nickel Anodes, W. Fraine, Dayton, Ohio; Motion Plating, H. J. Richards, St. Louis; Single Salts Solutions and the Results I Get, E. W. Heil, Wichita, Kan.; Some Plating Solutions I Have Known, Geo. B. Hogaboom, New Britain, Conn.; Criticism and Comment, Joseph Walters, Richmond, Va.; The Future of the Society, C. H. Proctor, New York City.

Much interest was shown by the delegates and visitors in the splendidly equipped laboratories and plating department of the N. C. R. Co., where working exhibits of equipment and processes were shown, they being especially interested in the demonstration of cobalt plating by W. L. Savel, of Queens University, Kingston, Ont.

A very interesting and extensive exhibit of samples of plating and metal finishing in the foyer of the Hall of Industrial Edu-



Group of Delegates Attending Convention of American Electro-platers' Society, Dayton, June 3-5, 1915

cation was crowded at all times, many beautiful specimens of all phases of the art being represented. The exhibit was made a special feature of the convention, and judging from the enthusiasm shown, was a complete success.

Saturday morning was devoted to visits of inspection of various factories, and the afternoon was given over to an automobile trip to points of interest about the city, the National Military Home, and to Hills and Dales and the N. C. R. Country Club.

The convention closed with the annual banquet Saturday evening at the Algonquin Hotel, with everybody pleased with the work accomplished, and convinced that this convention will prove a strong factor in the future growth of the society.

Delegates

J. H. Hansjosten, Chicago Branch.
H. J. TerDoest, Cleveland Branch.
O. E. Servis, Chicago, Ill.
H. E. Willmore, Chicago, Ill.
J. H. Goldhauer, Cleveland, Ohio.
S. P. Gartland, Rochester, N. Y.
Edward Hale, Cleveland Branch.
T. C. Eieckstadt, Detroit, Mich.
J. Schultz, Detroit, Mich.
W. G. Stratton, Bridgeport, Conn.
H. J. Richards, St. Louis, Mo.
E. J. Cusick, St. Louis, Mo.
H. H. Williams, St. Louis, Mo.
W. S. Barrows, Toronto, Canada.
H. Schuldt, Toledo, Ohio.
H. M. Dawson, Bridgeport, Conn.
A. E. Wehmore, Detroit, Mich.
George B. Hogaboom, New Britain, Conn.
F. Nordman, Cincinnati, Ohio.
T. H. Tarmer, Cincinnati, Ohio.
Arthur Nelson, Indianapolis, Ind.
B. D. Aufderheid, Indianapolis, Ind.
J. Walsh, Indianapolis, Ind.
Walter Fraine, Dayton, Ohio.
A. Lamoureux, Dayton, Ohio.
Leslie Pierce.
J. E. Sterling, New York City, N. Y.

Visitors

Ernest Lamoureux, Chicago, Ill.
W. E. Symonds, Lowell, Mass.
Thomas A. Trumbone, New York.
George W. Griffiths, Detroit, Mich.
Charles H. Proctor, Arlington, N. Y.
Walter L. Savell, Deloro, Ont., Canada.
Joseph Walters, Richmond, Va.
R. O. Kruger, Cleveland, Ohio.
John Nelson, Chicago, Ill.

J. P. Manz, Chicago, Ill.
H. H. Poabeck, Chicago, Ill.
M. S. Herman, Chicago, Ill.
Harry Starrett, Dayton, Ohio.
Walter J. Allen, Grand Rapids, Mich.
H. C. Elmore, South Bend, Ind.
W. P. Parsons, Chicago, Ill.
H. Duebelleis, St. Louis, Mo.
H. de Joannis, Bridgeport, Conn.
S. E. Huenerfauth, Chicago, Ill.
Gus Cruetz, Chicago, Ill.
Otto Halmlacher, Decatur, Ill.
W. Wells, Jr., Toronto, Ont.
James Humphrey, Toronto, Ont.
A. J. MacDermid, Wyandotte, Mich.
W. Blum, Washington, D. C.
A. L. Munning, Matawan, N. J.
H. Height, Indianapolis, Ind.
F. P. Davis, Chicago, Ill.
F. A. Bailey, Toledo, Ohio.
E. E. Greaves, Syracuse, N. Y.
L. E. Diamond, Chicago, Ill.
W. A. Throop, Syracuse, N. Y.
A. J. Fritz, Detroit, Mich.
R. H. Sliter, Cleveland, Ohio.
N. E. Dabolt, New York, N. Y.
L. Stander, Cincinnati, Ohio.
J. W. Jordan, Cincinnati, Ohio.
G. H. Niemeyer, Newark, N. J.
H. J. Blanchard, Niagara Falls, N. Y.
C. N. Manfred, New York, N. Y.
George Collier, Reading, Pa.
F. C. Mesh, Sherrel, N. Y.
R. D. Landrum, Cleveland, Ohio.
L. E. Shudorant, Philadelphia, Pa.
Thomas Whitehead, Cincinnati, Ohio.
E. B. Fritz, Chicago, Ill.
R. P. MacPherson, Pittsfield, Mass.
C. D. Dittman, New York, N. Y.
Stanley Tracy, East Orange, N. J.
Charles Buchanan, Cincinnati, Ohio.
M. A. Eiben, Cleveland, Ohio.
O. Pritchard, Indianapolis, Ind.
W. J. Terperny, Indianapolis, Ind.
J. H. Hinderman, Cleveland, Ohio.
William Sheckell, Cincinnati, Ohio.
F. E. Terrio, Chicago, Ill.
Emil Troxler, Newark, N. J.
Walter Schapper, Chicago, Ill.
William Wright, Muncie, Ind.
R. D. Armstrong, Marysville, Ohio.

Delegates and visitors were welcomed by the following members of the Dayton Branch, A. E. S.: Walter Fraine, Fletcher Gordon, Alphonse Lamoureux, Ohmer Stephens, Robert Suman, Charles Freund, Joseph A. Keyes, Forrest Hertzell, M. S.

Wade, Clarence Van Deran, John Krueck, Joseph Johnston, Christopher Hesch, B. Alph. Carr, Edward Hoehne, William Fansher, Gray D. Holdon, Felix J. Cyrex, Lester Cope, Leslie J. Pierce, William Hartzell, George Lantz, James I. Pace, C. F. Bettering.

Convention Notes

Charles H. Proctor, of Arlington, N. J., the founder of the organization, was present.

Dr. William Blum, of the Government Bureau of Standards, was in attendance.

tractive, and even artistic examples were displayed. The exhibitors included also some of the leading supply houses.

List of Exhibitors

Bennett-O'Connell Co., Chicago, Ill., represented by Martin J. O'Connell and Gus Crentz.

Boorum Pease Co., St. Louis, Mo., represented by H. Duebelbeis. Loose-leaf devices.

Brunhoff Mfg. Co., Cincinnati, Ohio. Etching work.

Thos. Buchanan Co., Cincinnati, Ohio,



Exhibits Displayed in Hall of Industrial Education

His address at the Round Table meeting in the hotel was most cordially received.

The evening meetings gathered in the Sun Parlor of the Algonquin, to which the public were invited.

The banquet at the Algonquin was just informal enough to be friendly and wholly enjoyable.

The exhibits were a magnet whose attraction was always in evidence.

The N. C. R. plating laboratories were not the least of the points of interest. They elicited much praise.

THE EXHIBITS

The foyer of the Hall of Industrial Education was set apart for the purpose of an exhibition by the trade. Very superior, at-

represented by C. W. Clayburn, plater. Brass tubing in one hundred different finishes.

Celluloid Zapon Co., Forty-fifth and La-Salle Sts., Chicago, Ill., represented by Frank Davis, Manager. Lacquer finishes.

Cincinnati Coffin Co., Cincinnati, Ohio, represented by F. H. Nordman, plater. Casket hardware.

Cleveland Branch, A. E. S. Casket hardware, harness fixtures, fish hooks, oil cups, auto parts.

Computing Scale Co., Dayton, Ohio, represented by Chas. Freund, plater. Mahogany and bronze finish scales.

Crown Rheostat & Supply Co., Chicago, Ill., represented by S. E. Huenerfauth. Rheostats.



Demonstrations of Carlsruhe Cleanser

Davis Sewing Machine Co., Dayton, Ohio, represented by Christopher Hesch, plater. Nickel plated parts.

Dayton Plating & Mfg. Co., Dayton, Ohio, represented by Clarence Van Doran, plater. Lamps, candlesticks and andirons, verde antique finish.

De Vilbiss Mfg. Co., Toledo, Ohio. Spraying outfits for lacquers.

Fansher Bros., Dayton, Ohio. Alkali and soap cleaners.

Haven Malleable Castings Co., Cincinnati, Ohio, represented by Henry Baum, plater. Saddlery hardware and slip nickel deposits.

Keeler Brass Co., Grand Rapids, Mich., represented by Walter J. Allen, plater. Builders' hardware.

The Lunkenheimer Co., Cincinnati, Ohio, represented by F. H. Farmer, plater. Steam fittings, oil cups, etc.

Millmore Corporation, South Bend, Ind., represented by Mr. Ellmore. Millmore products.

National Cash Register Co., Dayton, Ohio, represented by Walter Fraine. Medallions and bronze tablets.

Newark Branch A. E. S., represented by G. B. Hogeboom. Spoons and general hardware.

Leo Schmidt, Chicago, Ill. Two hundred sample finishes.

Southern Stove Co., Richmond, Va., represented by J. Walters, plater. Stove trimmings.

St. Louis Branch A. E. S. Stove trimmings in nickel.

The Stanley Mfg. Co., Dayton, Ohio, represented by Robert Suman, plater. Abrasive labels and medallions.

H. E. Willmore, Chicago, Ill. Two hundred and sixty-five samples of finishes.

Jas. H. Rhodes & Co., New York, represented by L. E. Diamond, R. O. Krueger and John Nelson, Demonstration of Carlsruhe Cleaner.

Roessler & Hasslacher Chemical Co., New York, represented by Carl Dittmar, Chas. H. Proctor and M. Hermann. Demonstration of metal cyanides for copper and brass solutions.

Northern Blower Co., Cleveland, Ohio, represented by M. Eiben. Exhibit of dust collecting systems, blowers, etc.

Driver-Harris Wire Co., Harrison, N. J., represented by Stanley M. Tracey, assistant sales manager. Exhibit of dripping baskets.

W. R. Parsons, Chicago, Ill., showing model of Parsons' Finishing and Burnishing Machine.

A Demonstration of Carlsruhe

A very interesting demonstration of Carlsruhe Cleanser was made in the plating room of the National Cash Register Co. by Mr. John Nelson, of the James H. Rhodes & Co., Chicago and New York. This created a great deal of interest among the delegates and visitors on account of the remarkable results which are being secured by the use of this material in removing oils and grease from metal surfaces.

One of the salient features of Carlsruhe is that it is not necessary to use benzine or

electric current as is the case with potash, lye and other alkalies. This saving in current alone is considerable, as it is not unusual to consume 50 amp. to the square foot, which at 6 volts equals 300 watts. Taking for example a tank 2 feet high by 3 feet long, the two sides will equal 12 square feet. The total amount of current consumed will be 3,600 watts. A horsepower is equal to 746 watts, but on account of the loss in conversion of about 20 per cent., it will require about 7 horsepower to furnish current for such a tank. Assuming that the cost of current is \$5 a month per horsepower, the cost of power will be \$35 a month.

But the cost of current is not all; a good deal of extra handling is necessary. Where current is used the articles must be placed on racks or wires so as to expose the entire surface to the action of the current and this adds to the cost of handling. With Carlsruhe the articles are simply placed in the solution in bulk, in baskets. Some manufacturers have a cage about the size of the entire cleaning tank which they fill up with work to be cleaned. The cage is then hoisted into the tank by means of a block and tackle which in turn rolls on a track. Another advantage claimed for Carlsruhe is that it does not tarnish copper or its alloys, including brass, bronze, etc. Nor does it attack tin or its alloys, such as solder. Therefore tin may be cleaned without loss of its lustre.

It is a common thing when tin or its alloys are cleaned in ordinary cleaning solutions such as lye or potash that the cleaning solution becomes saturated with tin, which is later deposited on articles of brass, etc., boiled in the solution. This causes blistering, peeling, etc. This trouble is entirely avoided where Carlsruhe is used. In one instance where Carlsruhe was used in cleaning coffin trimmings made from Britannia metal, two pieces were cleaned in lye and two pieces in Carlsruhe. After plating, the four pieces were handed to the superintendent of the metal department who readily picked out the ones cleaned in Carlsruhe as the brightest. The four pieces were then buffed and again submitted for inspection. The same two pieces were again selected as being the brightest. This is an important advantage in favor of Carlsruhe because it means that less buffing is required, consequently a saving in labor and

also a heavier deposit is left on the plated articles.

The self-cleaning features of Carlsruhe deserve special mention. After the solution is cooled off a scum is formed on the surface which contains the grease, etc., removed from the work. This can be readily skimmed off. After this is done the solution may be used again by simply adding enough Carlsruhe to replace that consumed in eliminating the grease. It is not necessary to throw the solution away on account of its becoming foul.

It has been demonstrated that Carlsruhe does not attack the hands of the operator as it is a non-irritant. This is a decided advantage as it is frequently necessary to handle the work in the process of cleaning. This eliminates the danger of burns, etc.

James H. Rhodes & Co., make a specialty of solving cleaning problems of all kinds relating to the plating trade and any of our readers having trouble of this kind should write their nearest office for advice and suggestions, which are furnished without charge.

The Parsons Finishing and Burnishing Machine

The Parsons Finishing and Burnishing Machine was demonstrated by means of a miniature model of the machine by the inventor and patentee, Mr. W. R. Parsons, of 411 S. Clinton St., Chicago. One of the most interesting features of Mr. Parsons' exhibit was a large collection of small metal pieces of various shapes, sizes and kinds which had been finished by the Parsons machine. These included innumerable pieces of stamped metal of very irregular shapes,

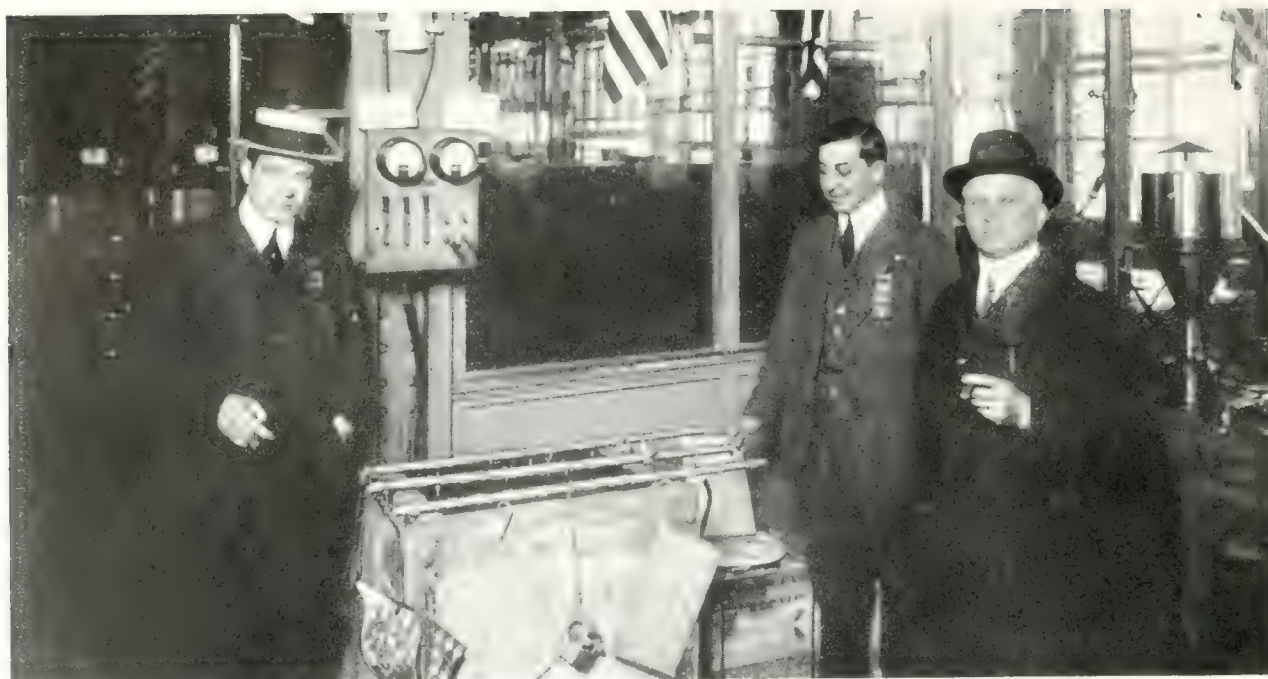
There are a number of novel features in the construction of the Parsons machine which are:

1st. Ease of operation, which is due to the method by which the barrel is supported at each end on heavy bearings so that the weight is distributed to these bearing points.

2nd. Ease of handling. By releasing the lever in the frame, the barrel automatically tilts to an upright position for inspecting the work and also for emptying and refilling the machine.

3rd. Saving of power. The cover of the machine can be instantly removed by throwing one lever and there are no bolts or nuts to be unscrewed, as is usually the case.

4th. Durability. The machine is lined



Demonstration of Metal Cyanides for Copper and Brass Solutions

throughout with $\frac{1}{8}$ -in. brass, which makes it practically indestructible.

5th. Substantial construction. The machine is made of No. 12 gauge cold rolled steel, the bottom and all joints being welded, which makes a much lighter and much stronger machine than is otherwise possible.

6th. Lubrication. One of the important features covered by the Parsons patents is the use of a neutral lubricant for the polishing process. After a long series of experiments Mr. Parsons has secured a special quality of lubricant which gives the best results and which he is putting out under the name of "Parshine."

Although balls may be used in the Parsons machine, the best results are secured by the use of small irregular steel pieces which are furnished especially for this process, and which will polish inaccessible corners and other parts of irregular shaped pieces in a way which has heretofore been impossible except by hand work.

Anyone interested in this process should write to Mr. Parsons for circular.

Practical Demonstration of Metal Cyanides

One of the most interesting exhibits was a practical demonstration of the Metal Cyanides by the Roessler & Hasslacher Chemical Company, of New York City. The company was represented by Mr. C. Dittmar, Mr. C. H. Proctor, and Mr. M. Herman.

The demonstration consisted of the operation of a fifty gallon brass and copper solution which enabled the visitors to determine the results to be obtained with these chemically pure salts under actual shop conditions.

Mr. Proctor gave a convincing talk on the advantages and economy of the Metal Cyanides, and pointed out the decided advantage of using a highly concentrated metal salt free from inert matter and impurities in place of metal salts containing large proportions of waste material.

Solutions prepared contained a larger amount of actual metal per gallon without increasing the density of the solution. Perfect deposits were obtained instantaneously and comparative tests were made which showed that with the solution made up the time of deposit could be materially reduced. According to comparative data furnished, it was proved that with the Metal Cyanides the plater could reduce his plating costs about 25%.

It was pointed out that the Metal Cyanides enabled the plater to standardize his solutions as a bath made up with the Metal Cyanides contain only the active ingredients necessary in a plating solution without any detrimental matter.

The demonstration proved of especial interest as those present were made to realize that due to the abnormal prices of copper and spelter, copper and brass plating would assume larger proportions in the future.

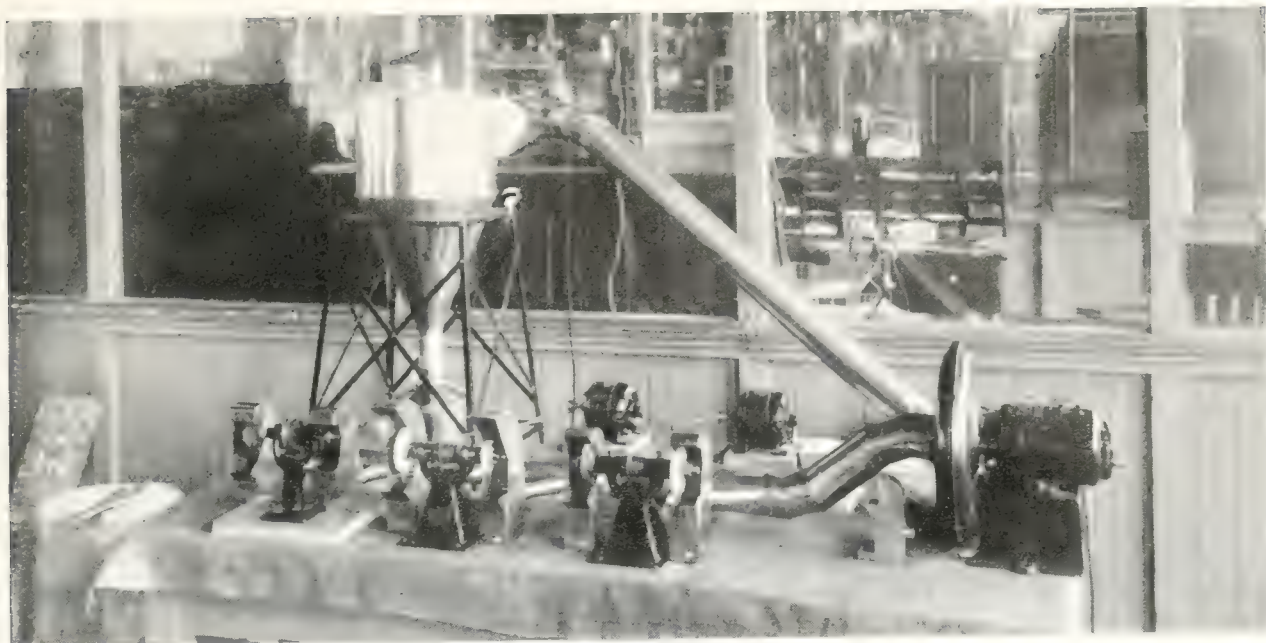


Exhibit of Northern Blower Co.

The Northern Blower Co.

A complete working model of a dust collecting and conveying system as used in grinding and polishing rooms, was a very interesting feature of the exhibit of the Northern Blower Co., 4515 Storer Ave., Cleveland, Ohio. This exhibit consisted of several small grinding and polishing machines equipped with the latest improved forms of hoods as manufactured by this company. These were connected with a motor-driven suction blower and a receiving tank as shown in the illustration.

By means of this model equipment, Mr. M. Eiben, who was in charge of the exhibit, demonstrated a number of features of merit, which the Northern Blower Co.'s system possesses. Particular attention was called to the design and construction of the hoods, which combine simplicity, strength and safety to a remarkable degree. The design of these hoods is such that there is no sharp suction of air at front of the wheel where the operators body is close to it, which generally results in rheumatism, kidney trouble, etc. This feature also protects the operator from flying objects that get away from and carry around the wheel, which often happens with the ordinary types of hoods, having a sharp suction at point of wheel.

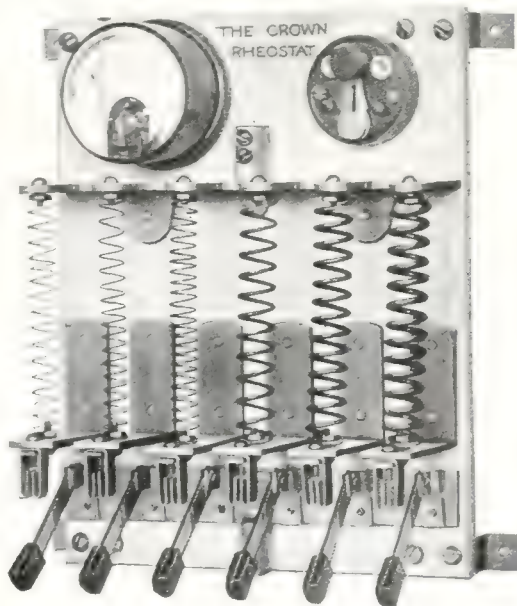
In the improved form of hood, there are no loose slides nor hinged side doors to get in operators way, while at the same time the hood may be opened, leaving the entire wheel exposed. These hoods are built of heavy galvanized iron reinforced with band

iron, making a very substantial and durable form of construction.

The Northern Blower Co. design and install complete systems for collecting and conveying dust and other materials adapted to meet any given condition and requirements. They also manufacture ventilators, tanks, stacks, etc., and all kinds of sheet metal work.

Crown Rheostat & Supply Co.

An interesting exhibit of rheostats was made by the Crown Rheostat & Supply Co., 15-17 Desplaines St., Chicago. This was in



charge of Mr. S. E. Huenerfauth, who was kept busy explaining the advantages of Crown rheostats for plating work. Three types of these rheostats were shown: Type M rheostat only; Type MV, a combined

rheostat and volt-meter, and Type MVA, a combination of rheostat, volt-meter and ammeter.

These rheostats possess a number of features to be found in no other similar devices on the market. The Types MV and MVA rheostats give the plater full knowledge of the current consumed in the plating solution and by eliminating guesswork, enable him to secure results which are otherwise impossible.

For controlling the current to meet certain requirements and conditions, these rheostats fill the bill completely. The regulation by means of a number of switches makes a great many different combinations possible, so that the current can always be regulated to a degree of nicety never before obtained. By this means the current can be raised in equal divisions, according to the size of the resistance coils, making it possible to regulate the current according to the amount of work in the solution at any time. This is an important feature which is readily recognized by every practical plater, as the proper regulation of current has a great deal to do with getting satisfactory results.

While extensively used on all kinds of solutions, Crown rheostats are especially recommended for silver and black nickel, for which they are distinctly superior to any other. They are indestructible, as it is impossible to overload them and burn them out. They are built of non-corrosive material and a composition base is employed which is absolutely fire-proof and heat-resisting.

Mr. Huenerfauth reports that there is a

large and increasing demand for Crown rheostats and that in many cases they have received orders to replace the entire equipment in plating rooms. Crown rheostats are used at the plant of the National Cash Register Co. and during the convention an order was received for eight rheostats from the Crown Hardware Mfg. Co., Dayton, Ohio.

Celluloid Zapon Co.

The wonderful possibilities of lacquers have probably seldom been so well demonstrated as by the exhibit of the Celluloid Zapon Co., which occupied considerable space in the Exhibit Hall.

Until a comparatively recent date lacquers were used only as a protection against corrosion and tarnishing, and the idea of using them to add to the finish and to get a variety of finishes, and thus increase the line of production, is a recent development of the Celluloid Zapon Co. The exhibit of this company, which is shown in the accompanying illustration, included upwards of one hundred pieces of French Bronzes, Barbediennes and in antiques and so-called Verde-antique finishes. While the illustration indicates the great variety of work displayed, it does not convey any idea of the wonderful finishes, many of which have never before been secured by any other process. The exhibit of the Celluloid Zapon Co. may be well said to mark a new era in the plating business on account of the beautiful and artistic results which have been secured by the use of lacquers by this company.

This exhibit was prepared by the Chicago



Celluloid Zapon Co.'s Exhibit

Branch of the Celluloid Zapon Co. under the direction of Mr. Frank P. Davis, manager of the Chicago Branch. The Chicago Branch is a comparatively new one, having been opened the first of this year. It is a complete establishment in every way and occupies nearly a half block of land with side track and exceptional facilities for making prompt shipments. A full line of lacquers of every description is kept constantly on hand.

In addition to Mr. Davis, who had charge of the exhibit, the following representatives of the company were present: Mr. N. E. Dabolt, New York representative; Mr. R. H. Sliter, Ohio representative; Mr. L. E. Sturdevant, Pennsylvania representative.

Branch Meetings

The New York Branch of the American Electroplaters Society elected a new board of officers at its May meeting. The following were installed: President, Herman H. Reama; vice-president, Joseph Minges; secretary-treasurer, William Fischer; recording secretary, John Painter; sergeant-at-arms, R. E. Masseccotte; assistant sergeant-at-arms, William B. Shanks; librarian, J. A. Stremel. The Board of Trustees are Thomas B. Haddon, William Schneider, N. E. Dabolt, B. Popper and John Sterling.

The annual outing is set for June 20, at Glenwood, L. I.

The American Electro-platers' Society, Buffalo Branch, held a very interesting and well-attended meeting on June 4. The papers and following discussion held the interest of members until a late hour.

Nickel-Plating Aluminum

Le Chatelier's process of nickel-plating aluminum consists first in a preliminary scouring of the aluminum in a bath of hydrochloric acid containing a certain portion of iron. The iron is precipitated on the surface of the aluminum forming a kind of network. When this is passed into a nickel bath the nickel becomes entangled in this network and adheres strongly to the aluminum. This process is based on a physical action and appears to solve the problem, hitherto considered impossible.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES

Bridgeport—Meets on the third Friday of each month at 260 John Street, Bridgeport, Conn. Secretary Nelson Barnard, 858 Howard Avenue, Bridgeport, Conn.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, S. Wrobereski, 1486 Elmwood Avenue, Buffalo, N. Y.

Chicago—Meets fourth Saturday of each month at 8 P. M. at Western Building, Randolph and Michigan Avenue. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Avenue, Cincinnati, Ohio.

Cleveland—Meets last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Avenue, Cleveland, O.

Dayton—Meets first Wednesday of each month at Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 First Street. Secretary, B. E. Miller, 543 Townsend Avenue, Detroit, Mich.

Indianapolis—Meets last Saturday of each month at the Denison Hotel. Secretary, Arthur Nelson, 1617 Shelby Street, Indianapolis, Ind.

Milwaukee—Meets second Wednesday of each month at Marquette University. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 West Madison Avenue, Irvington, N. J.

New York—Meets fourth Friday of each month at 258-262 Pearl Street, New York City, at 8 P. M. Secretary, Wm. Fischer, 345 East 23d Street, New York.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Rochester—Meets second and fourth Friday of each month at University of Rochester. Secretary, C. V. Haring, 603 Dewey Avenue, Rochester, N. Y.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, H. H. Williams, 2134 Nebraska Avenue, St. Louis, Mo.

Toledo—Meets every Wednesday at Toledo University. Secretary, James E. Nagle, 209 Navarre Avenue, Toledo, Ohio.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Some Rare Metals

Tellurium

Tellurium belongs to the same chemical group as sulphur and selenium, but unlike these two elements, tellurium is a metal and resembles antimony in a general way. Tellurium fuses at 500 degrees centigrade, and when heated above this point it burns with a fine blue flame to tellurium dioxide, at the same time evolving a very peculiar odor. Its combination with hydrogen forms the very poisonous and colorless gas hydrogen telluride.

Tellurium alloys readily with copper, but the resulting metals are of no value as far as can be foreseen at present; when added to copper in the proportion of 0.5 per cent. it acts as a deoxidizer and quietens the metal to the point of being almost sound as far as appearances go. The heads and risers attached to the casting swell to a slight convexity in the center. The copper does not "spit" when ascending the riser, as it would when selenium is used in the same proportion, but in all other respects the two elements have very much the same effect on copper. The metal is rendered porous and its physical properties are greatly impaired, the effects being similar to those of sulphur, but in an accentuated degree.

When lead was added to tellurium treated copper to form an alloy of 50 per cent. lead and 50 per cent. copper, the result was to make the metal extremely lively when in a molten condition, and the melt bubbled strongly, and although poured at a low temperature, as well as could be judged without any precedents to act as a guide, the metal continued its ebullition until the heads solidified, which seemed an abnormal length of time. The result was an extremely bad sample of the molder's art, the casting being filled with irregular holes and consisting partly of metallic lead. Tellurium, therefore, acts differently from sulphur in highly leaded alloys, as the latter element prevents to a certain extent the separation of the lead, while tellurium promotes this separation.

Various deoxidizers were also tried in connection with tellurium treated copper-lead alloys but without the slightest valuable effect, as far as could be determined.

In the case of aluminum, tellurium appears to be void of injurious effect. When added to this metal in the proportion of 2

per cent. in conjunction with 8 per cent. of copper, which in effect was the number 12 alloy treated with 2 per cent. tellurium, the ductility of the alloy appeared to be increased very materially. The sand castings from this alloy when broken showed traces of a crystalline structure, but this was not evident in the case of the chill castings. With the addition of 10 per cent. tellurium the number 12 aluminum was hardened and given a decidedly crystalline structure. The fluidity of the alloy was not impaired apparently in the least. An alloy of pure aluminum with 10 per cent. of tellurium was used to make a bronze containing 10 per cent. of the aluminum—tellurium combination. The alloy was cast in sand molds for the purpose of making fracture tests which form an excellent means of judging the character of an alloy. The resulting castings were of a dirty yellow color externally, and their surface was speckled with minute cavities, which, however, were very superficial, being easily removed by a few strokes of a dead smooth file, exposing clean metal. The alloy thus formed was softer than a 10 per cent. aluminum bronze, its hardness number being 65 Brinell, while the scleroscope hardness varied from 18 to 32.

Such variation, however, is not unusual in the case of bronze. The alloy had been cast into a bar about 6 inches long and of rectangular section $1\frac{1}{4}$ inches by 1 inch. The bar was cut with a hack saw across its widest face to a depth of $\frac{3}{8}$ inch, and was then placed across supports and was broken by a sledge. The alloy was quite as tough as a 9 per cent. aluminum bronze usually is, as it required many blows of the sledge to break through the remaining $\frac{5}{8}$ inch of metal, the bar being considerably battered in the effort. The fracture thus revealed was very clean, with fine interlaced crystals. It was thus apparent that 1 per cent. of tellurium had not injured the physical properties of the bronze, but before the rule of thumb methods were superseded by more scientific methods and regular test bars for tensile and other tests were made, it was considered advisable to determine whether the rather favorable results just recorded could be duplicated in subsequent castings.

The result was that in all other casts except the first one, gas or shrinkage cavities were found invariably in the heart of the test bar, and on cutting up the first bar an elongated cavity was found not in the center,

but at the end where the riser had been placed.

The fracture of the bars apart from the gas cavity was in all cases good and the alloy very tough, but the gas cavity defied the biggest feeders, and the most powerful deoxidizers, if it was not at the center it would be at the end of the bar; therefore, it was reluctantly concluded that tellurium was better left out of such alloys. The result of the experiments was negative; it was found that tellurium was positively injurious, much more so than sulphur, to copper and all its ordinary alloys, and therefore should be kept strictly away from such metals, which fortunately is not difficult to do as tellurium is a stranger to most founders, and even if it works its way in as sometimes happens, in combination with more ordinary metals, it is not likely to be present in amount sufficient to do much harm.

The copper and the zinc plates projecting from our galvanic cell are at a difference of potential, the copper being positive and the zinc negative. If these two electrodes are connected through a conductor, a current will flow from the copper to the zinc. This tends to discharge the electrodes, but as soon as a current flows the equilibrium of forces is destroyed and more zinc goes into solution and more hydrogen leaves the solution. Inside of the cell, therefore, the current flows from the zinc to the copper electrode. As soon as the external conductor is broken equilibrium is again established.

The comparative cheapness of zinc and the large difference of potential which it is possible to obtain with this metal make it a nearly ideal fuel for galvanic cells. Owing to the impurities which are ever present it is necessary in many cases to use mercury in the casting of zinc electrodes or to coat the zinc with mercury to form a zinc amalgam. The reason for doing this is readily understood. Suppose the zinc electrode contains a little foreign metal such as copper. Then if it were placed in an electrolyte such as sulphuric acid solution, a miniature short-circuited battery would be formed on the surface of the zinc, which would tend to destroy the zinc and shorten the useful life of the cell. This is known as *local action*. The mercury prevents this action to a large extent by surrounding the particles of foreign substance.

Many of the various combinations of electrolytes and metals do not give a constant difference of potential between the electrodes.

The potential gradually decreases as the current continues to flow. This decrease in potential is said to be due to *polarization*. The effect is due largely to the collection of hydrogen bubbles on the positively charged plate. These bubbles disconnect a part of the plate from contact with the electrolyte. Moreover, the collection of the hydrogen around the positive pole and the oxygen or a non-metallic radicle around the negative pole may so change the combinations of potential differences that there is a difference of potential opposing the primary potential of the cell. This results in a decrease in the external potential difference of the cell. Polarization also occurs in plating solutions and the reader may have observed that it was impossible to cause any deposit from certain solutions until the applied potential difference (measured by the voltmeter) had been raised above a certain fixed value. This is due to the fact that the plating solution exerts a counter potential which stops the flow of current until the applied potential is raised above the limit of this counter potential.

The theory of the conduction of electricity through solids and through electrolytes has been discussed. The electrical difference between solid conductors and electrolytes has also been pointed out:—that electrons are passed from molecule to molecule, or atom to atom, in the solid conductors, while in electrolytes the molecules split up into anions and cations, which travel with their charges. Our study of the functions of electrolytes would be incomplete without some brief mention of their action in the galvanic cell or battery.

Plating solutions may be regenerated (they may dissolve metal from the anode as it is deposited at the cathode), or they may be exhausted of their metal but using insoluble electrodes. In either case the ions are directed by a difference of potential between the electrodes. Now if it were possible to cause the plating operation to be carried on by some mechanical, heat or chemical means, we should expect to obtain a difference of potential between the electrodes by producing unlike charges upon them. Likewise if we could cause the metal of the anode to go into solution in the ionic state we would expect to find a difference of potential between the electrodes. Such action can be brought about.

About 1786 an Italian by the name of Volta was led to conclude from certain experiments which he conducted that unlike metals when in

contact exhibit a difference of potential. It has since been shown that the potential differences which he observed depend upon the nature of the surfaces exposed to the air, the temperature and the chemical nature of the metals. The potential difference due to the contact of the metals alone,—disregarding the fluid in which they are placed,—is undoubtedly of a very small order. The discoveries of Volta and his cousin Galvani, however have led directly to the development of the primary battery or galvanic cell. It has been found that a difference of potential exists between metals and electrolytes and that this difference in some cases attains a value of importance. When a strip of copper and one of zinc are placed in a dilute solution of sulphuric acid, the copper assumes a positive potential with respect to the sulphuric acid and the zinc a negative potential. The value of the difference of potential between the copper and the sulphuric acid solution is a little less than half an electrical unit (the volt) while the difference between the zinc and the acid is a little greater than half a unit. Since one is negative and the other positive, the total difference of potential between the copper and the zinc is about one electrical unit. The reason for this addition of potentials may be more clearly seen by referring again to the analogy in Fig. 8. If we let the level of B represent the potential of the copper strip, O the potential of the sulphuric acid, and the level of D the potential of the zinc, we can readily see that the difference in level between B and D is the total vertical distance between them.

Other combinations of metals and electrolytes will be found to produce other values of potential difference. For example the common sal-ammoniac cell which employs carbon and zinc electrodes in ammonium chloride has a potential of about 1.6 electrical units (volts). If the electrodes of such a cell are connected by a conductor such as a copper wire a current will flow through the conductor. The zinc will be seen to dissolve gradually as the current continues to flow.

Since the differences of potential between metals and electrolytes is a property of the metals and solutions, one of the following conditions is necessary for the production of differences of potential external to the cell:—(1) two different electrodes must be used with a single electrolyte or (2) two electrolytes must be used with like electrodes.

The second condition is fulfilled if a solution of an acid, a base or a salt is at different

densities or temperatures around the electrodes. Condition one is by far the more important although a combination of both conditions, consisting of different electrodes in two different electrolytes is sometimes employed.

We are indebted to Walter Nernst, inventor of the Nernst lamp, for a consistent explanation of the contact difference of potentials which exist between a metal and an electrolyte. This explanation is based upon the ionic hypothesis of Arrhenius. According to this ionization theory the dissolving of an acid, a base or salt in water is accompanied by a splitting up of the molecules into ions. Nernst adds to this theory the conception that a metal in certain combinations with electrolytes (such as the zinc in the preceding example of the zinc copper and sulphuric acid cell) has a tendency to go into solution in the ionic state. In other words the zinc ionizes. There is, however, a distinct difference between the ionization of a salt, acid or a base and the ionization of a metal like zinc. When the ionization of a salt, acid or base takes place, both positive and negative ions are formed carrying equal but opposite charges. The electrolyte as a whole is, therefore, neutral. In the case of zinc and sulphuric acid solution each zinc ion that is formed carries a definite positive charge into the solution, causing the electrolyte to become positively charged and leaving the zinc plate negatively charged. No negative ion is formed.

Faraday found that a very definite amount of electric charge was associated with a given amount of metal or non-metal. This means that the quantity of electricity which must pass through a silver solution in order to deposit an ounce of silver is always the same.*

Faraday also found that the same amount of current passing for a given time would deposit weights of elements or groups of elements which are proportional to their chemical equivalents. Since some elements have more than one chemical equivalent, they also have more than one electro-chemical equivalent. Thus the quantity of electricity which will deposit 108 grams of silver (the atomic weight) will deposit about 63 grams of copper from cupric compounds or 32 grams from cuprous compounds. The above facts are known as *Faraday's Laws*.

To return to the consideration of the pressure existing between zinc and a sulphuric acid solution, we conclude from Faraday's laws that a given weight of ions of zinc going into

solution carry a definite amount of electric charge. The ionization of the zinc like the ionization of a salt cannot continue indefinitely. There seems to be a definite solution pressure which tends to draw the ions into solution, until the charges held by these ions and by the zinc plate exert sufficient force to overcome the solution pressure and establish an equilibrium. The solution pressure is affected somewhat by the density of the solution and the temperature. Equilibrium in many cases is established without any apparent chemical action, because of the large quantities of electricity which the ions carry. For example, the amount of zinc which goes into solution to establish a difference of potential between the electrolyte and the zinc plate is not ponderable, because each ion of zinc carries an enormous charge.

On the other hand, we may have a combination of a metal and an electrolyte such that the tendency of the ions of the electrolyte is to leave the electrolyte. If this tendency is greater than the solution pressure which tends to hold the ions, the ions will leave the solution. This is the case with copper and a sulphuric acid solution. The hydrogen ions leave the solution, causing the copper plate to become positively charged. Another equilibrium is then established between this potential and the solution pressure.

The Uses of Colloids in Plating Solutions

By E. S. THOMPSON

The writer has from time to time noted inquiries as to why gelatin, glue, etc., prove beneficial to certain solutions when added to them, and as no answers were given which could be regarded as satisfactory, he undertook to solve the problem of just how the addition of the organic matter mentioned could effect any changes in a plating solution which would prove beneficial.

It is well known that the solutions of lead and tin, when made up with caustic soda and potash as a solvent, have a tendency to crystallize and deposit as a metallic powder, even with a voltage far below that necessary to decompose the water of the solution. The crystallization of the lead and tin under the influence of the electric element is no doubt due to the catalytic force of the solvent for the salt, the elec-

tricity separating the metal from its solvent without the solvent itself undergoing decomposition, and consequently the action of the electricity was that of attaching itself to the metal by a cohesive force rather than combining with the dissolving agent or the water of solution.

The writer carried on some experiments through the months of January and February to determine the quantity of lead salt which could be used to each gallon of solution, and noted the results obtained.

The first solution made up was a formula taken from a trade journal which recommended 16 oz. caustic soda, 4 oz. litharge and 4 to 5 volts. It was impossible to obtain a satisfactory deposit from this solution at any temperature or any voltage. The lead was deposited in crystals, even with one-half volt. With four volts a spongy mass was deposited in a few minutes, which could be easily detached and floated upon the surface of the solution, its buoyancy no doubt being due to the occlusion of hydrogen. One-quarter ounce of common glue for each gallon of solution was then added, and the solution heated to 140 deg. F. An apparently homogeneous deposit of lead was then obtained in ten minutes, but when the articles had been rinsed in running water, dipped in hot water, dried in sawdust and hung out to dry, a white salt formed upon the surface, the deposit of a bluish color, which was supposed to be lead, disappearing in a few hours. It is evident from this experiment that sodium, either as hydride or in a metallic state, was deposited with the lead, and that the moisture of the atmosphere had aided in converting what lead was deposited into oxide, and the sodium into hydroxide. After repeated efforts to obtain a pure metallic lead deposit from this solution varying the temperature and the current density, and each effort being attended with failure, the solution was diluted to one-third its former concentration, and the deposit showed considerable improvement, the addition of one-quarter ounce more of glue to each gallon giving a very satisfactory deposit at two and one-half volts.

Another solution was made up according to Langbein (formula No. 1): Caustic potash, 7 oz.; litharge, 0.68 oz.; water, 1 gallon, and heated to 175 deg. F. This solution gave the same colored deposit as the previous one, which was reduced to a white

powder by exposure to the atmosphere, and identically the same results until 0.68 oz. of common glue for each gallon of solution was added, when a dense, uniformly gray colored coating was obtained on either steel, copper, or nickel plated articles. The deposit remained unchanged when exposed to the air.

The glue acts as a filter for the lead (the glue not being perfectly soluble), preventing any crystalline substances from passing through it, allowing only the lead, which is in perfect solution, to reach the cathode, where it is deposited, not by a direct action of the current, but as a secondary reaction, the electricity combining with the hydrogen of the water and the potassium in solution without depositing the potassium either as a hydride or in a metallic form. The glue is also a powerful oxidizer, taking up the oxygen forced out at the anode, leaving a metallic surface and carrying the oxygen to the cathode, where the hydrogen is oxidized. It will be seen that the glue performs a double duty in lead and tin solutions. In acid copper solutions the colloids act very much the same, those derived from animal matter being given the preference over those of the vegetable. The quantity of colloidal substances which may be used is governed by the metallic content of the solutions, the relative contents of which the writer has not yet been able to determine. But the metallic content in tin and lead solutions must be so low, also the content of caustic potash or soda, that the hydrogen of the water must aid in taking up the electricity flowing into solution. If the water is anything like half saturated with caustic soda or potash their catalytic action is so great that separation of crystalline lead, together with the alkaline metal, takes places as a direct action of the current and homogeneous and adherent deposits are impossible.

The deposition of lead and tin from caustic solutions must be a secondary reaction, and the colloidal matter must be equal to the oxygen set free.

The answer, in one instance, as to how glue aided in obtaining a homogeneous lead deposit was, "It is not dissolved by the water and serves to moisten the cathode, thus removing the hydrogen." I do not think it is possible to obtain an adherent deposit when the cathode is kept "wetted." The cathode must be made perfectly dry by

the decomposition of the solvent, the electricity combining with one of the elements of the solution, releasing it as a gas upon the cathode, which gas may be instantly combined with another element so that no perceptible decomposition takes place, and the metal deposited at the instant of the separation of electricity from its combination with the other element.

The Conductivity of Cathode Copper

In the course of a discussion on the melting of copper in an electric furnace, Lawrence Addicks states in Bulletin 96 of the American Institute of Mining Engineers that his idea of the reason why melted copper does not give as high a conductivity as pieces drawn directly from a cathode or native copper is that in the latter case the impurities are present as a mechanical mixture, while after melting they are chemically combined with the copper, which is a very different condition. Further, it is necessary to take the sample from a relatively smooth and consequently pure part of the cathode, as otherwise it would not draw. The same with the mass of the copper, a good solid part is picked out, which is not representative. In fact the refiners have all found they could not take fair samples of cathodes for a chemical analysis. It is always customary to use wire-bar copper for the purpose of sampling, and the impurities are several times as great as shown by samples taken from the cathodes.

Regarding the oxygen content of copper, copper dissolves gases the same as other metals when it is molten. Workers of silver know well how it spits as it cools, everyone knows how iron "pipes," and copper does exactly the same thing. I am not sure it is oxygen it absorbs; it may just as well be CO or CO₂; but there is no difficulty in getting rid of oxygen in the present type of furnace. The only difficulty is that when the oxygen is poled out the copper "spews." I have taken copper wire bars containing practically no oxygen which were in horrible shape physically and they rolled perfectly as far as conductivity goes, and there was no trouble at all with the copper, so that if we melted copper in a neutral atmosphere it does not follow that we would be able to do so without the cuprous oxide and get a perfect casting.

Increasing the Output of Your Foundry

By G. K. HOOPER*

Like every other manufacturing establishment, a foundry is a device for making money out of labor; therefore, in designing such a plant, every means should be embodied to enable the laborers, whether skilled or unskilled, to do the utmost useful work which they are reasonably able to perform, having in mind their bodily, mental and social necessities.

In the early beginnings of the foundry business, so little information was available concerning its fundamental sciences of metallurgy, practical geology and the hydrodynamics of molten metal that skill in an operative was largely a matter of intuition or genius. The trade, therefore, being built upon this, has not adapted itself as freely as possible to the subdivision of labor and use of mechanical appliances as have other trades, and the productiveness of the labor in it has not advanced rapidly. The processes, also, under this condition have a tendency to be wasteful in time and space.

In the foundry where no subdivision of labor is used, this productiveness averages, according to studies which I have made, from 50 to 60 per cent. With the subdivision of labor and the use of mechanical appliances and power, it rises to about 75 per cent. With well arranged machine tools in the machinist trade we are advised that the productivity of the labor has risen as high as 80 per cent., and on some classes of work to a higher figure.

As there are yet a number of foundry executives who believe that it is unwise, if not impossible, to use machinery and divide their labor, or in other words, to use what is known as the gang system, I would like to quote what Adam Smith, the first great expounder of economics, says about subdivision of labor in his work known as "The Wealth of Nations," written about 1755. He speaks as follows:

The greatest improvement, in the productive powers of labor and the greater part of the skill, dexterity and judgment with which it is anywhere directed or applied seems to have been the effects of the division of labor. The great increase in the

quantity of work which in consequence of the division of labor the same number of people are capable of performing, is owing to three different circumstances:

First—The increase of dexterity in every particular workman.

Second—To the saving of time which is commonly lost in passing from one species of work to another.

Third — To the invention of a great number of machines which facilitate and abridge labor and enable one man to do the work of many.

It is the great multiplication of the production of all of the different arts in consequence of the division of labor which occasion in a well-governed society that universal opulence which extends itself to the lowest ranks of people. Every workman has a great quantity of his own work to dispose of beyond what he himself has occasion for, and every other workman being exactly in the same situation, he is enabled to exchange a great quantity, or, what comes to the quantity of his own goods for a great same thing, for the price of a great quantity of theirs. He supplies them abundantly with what they have occasion for and they accommodate him as amply with what he has occasion for, and a general plenty diffuses itself through all the different ranks of society.

This sounds something like a treatise on the evils of restricting output. Mr. Smith gives also some statistics concerning results of subdivision in the pin and nail-making industries, generally as follows: With pins, one man by hand could make but about 20 per day, or 10 men could make 200 per day; whereas, by subdivision of the 18 different operations and with indifferent machinery, 10 men do make about 48,000 per day. With nails, he reports:

A blacksmith who has been accustomed to make nails can seldom with his utmost diligence, make over 800 to 1,000 nails per day. I have seen several boys under 20 years of age who had never exercised any other trade but that of making nails, and who when they exerted themselves could make,

*Presented at a meeting of the Newark, N. J., Foundrymen's Association.

each of them, upwards of 2,300 nails per day, the same person blowing the bellows, stirring and minding the fire, heating the iron and forging every part of the nail, being also obliged to change his tools in forging the head.

We might conjecture from the foregoing that there were scientific management and efficiency experts, even as early as 1750, and that achievement in the efficiency profession has fallen off since that time as no such percentages of improvement as the above figures entail, are offered us to-day. With the better technical understanding which now exists concerning the underlying sciences of the foundry trade, there is more and more application of engineering talent to the investigation of the problems which arise. It is also as much a matter of engineering to find out what the human machine can be reasonably expected to perform as it is to properly judge the fitness of any mechanical device for foundry operation.

In foundry design, quite as much as in any other occupation, the quantity, quality and form of the product establish the limits within which a design must be contained in order to reach that most desirable situation, the providing for improvement of plant and equipment and the obtaining of substantial net profits.

Application of Labor to Product

The application of labor to the product is the next consideration. If skilled labor is necessary, means must be used to apply the skill only to those operations in which it is needed, subdivision of labor and the use of mechanical appliances and power being embodied wherever this can be profitably done.

In the molding and casting operations a considerable number of foundries to-day do sub-divide the labor on their product and employ separate labor gangs for pouring, shifting and shaking out, sand-handling and core-setting. Some objection is made to this practice, but, as you have heard, it is sound economics to sub-divide the labor, when the amount of product warrants it and an increase of skill may reasonably be expected to result, giving an increased production with corresponding reduction of cost. Some confusion may arise at the commencement of such a method of operation, but this can be minimized by

using the most skillful and intelligent operatives as gang bosses.

To do away with the laborious part of lifting and transporting materials, there is the industrial railway with or without locomotive, the overhead monorail trolley track, either with or without power-driven traveling hoist, the air hoist, the jib crane, traveling wall crane and overhead crane which covers nearly the entire floor area. Combinations of these are frequently used.

For molding, molding machines of one kind or another, from the simple hand squeezer and the pneumatic hand rammer to the more elaborate power-ramming, pattern-drawing, rock-over type are available, each well adapted to some particular purpose. The molding machine is employed to advantage on a great variety of product and more and more uses are found for it every day. You are, however, familiar with mistakes which have been made in the wrongful selection of molding machinery for any given work resulting in confusion as to the merits of such devices, and in loss. The general proposition still exists, however, that molding machinery properly adaptable to the work will increase profitably the productiveness of the laborer.

Arrangements are made for improving the productivity of the pouring operations by bringing large quantities of hot metal to the work in bull ladles; by taking the molds to the melted metal, at or near the cupola; by trucks running on the floor; by cars on industrial tracks pushed by steam or electric locomotives, and by conveyors on which the molds are weighted or clamped, sometimes jacketed; poured while in motion; cooled and removed at the proper time and with flasks, bottom boards, weights, etc., returned to the molding stations while the sand and castings go elsewhere for suitable attention. There also are special forms of ladles, such as the multi-lip, which add to the productiveness of the labor.

Metal Melting

In melting equipment there is available for the cupola the tilting or rocking spout and the charging machine; for the reverberatory furnace in malleable work, the overhead traveler for lifting bungs and handling the fresh charge in dumping trays or ships; for the open hearth steel furnaces, the charging machine and gas producer. To these two latter types of furnace a num-

ber of attempts are being made to attach the mechanical stoker and to utilize also the direct burning of coal in powdered form. For non-ferrous metals there is the tilting furnace.

In sand-handling a number of devices are successfully used from the simple sand-cutting machine operating on the sand heap on the foundry floor to the complete apparatus which takes shaken-out sand, cools, cleans and tempers it, mixes it with the proper proportion of new sand and delivers it again to the mold maker.

In shaking out and handling castings, sprues, etc., mechanical appliances also have been developed from the simple grating on which molds are dumped to the complete conveyer which carries the shaken-out sand and castings to shaking gratings on which they are separated and from which they are discharged into some suitable arrangement for cooling, the sprues and runners having been disposed of at the proper time. The cranes, travelers and industrial tracks, previously mentioned, also are available for this work, it being a matter for study in each case whether it is more economical to move the iron to the molds by hand or mechanical means, or vice versa.

When quantities are large and the product such that a few sizes of molds may be standardized, even though of considerable difference in size, there will be combined all of these devices, such as the molding machine, sand-handling system, mold conveyor and shaking-out conveyor, all of the operations being conducted uninterruptedly throughout the entire working day. Attempts have been made to operate such plants by means of two or three shifts throughout the whole 24 hours. The success of this development so far is doubtful. You will recognize that such 24-hour operation could not, in any way, increase the relative productivity of the labor.

Cleaning Castings

In cleaning progress has been made from the hammer and chisel, steel brush and emery wheel to the power chipper, metal saw, sprue cutter, exhaust tumbler and sand blast machine. Long tumbling mills have been attempted a number of times in which the castings to be cleaned were fed in at one end and discharged fully cleaned at the other. These present attrac-

tive possibilities when material is fairly uniform in size and shape, and is not hollow, deeply cored, recessed or of considerable variation in size.

For these latter conditions it has been found that while certain sizes in the charge may be satisfactorily cleaned in this way, the whole contents will not be as satisfactorily cleaned, so that on the whole, these devices have been a success only where the work is uniform in size and simple in nature. The exhaust tumbling mill and the sand blast machines, such as the revolving and traveling table machines and the sand blast barrel each are in satisfactory operation to increase the productiveness of labor in cleaning operations. Mechanical appliances embodying grinding wheels are available, increasing the effectiveness in removing roughness. They also are used to roughly-dimension such pieces as can be finished in this way.

When large quantities of castings are made, which on account of being machined require careful cleaning to save time and tools, pickling plants, embodying mechanical handling, are designed in which the castings are handled on pans, acid poured upon them by ladles or from a hose connected with a reservoir to which the acid is again pumped after draining. The castings then are delivered to a washing floor where they are washed while still on the tray by streams of water under considerable pressure, after which they are dried and sorted. This means has given economical results for castings which are required to be very clean.

In the core department various problems present themselves calling for the application of subdivision of labor and of mechanical devices. There are sand driers, mixers for properly amalgamating the necessary materials, ramming machines of various types, cutting-off and pointing machinery, handling devices for saving steps for the coremakers and ovens, more or less elaborate, for making the best use of time, labor and fuel.

A raw material yard also is a problem for engineering thought. There we have lifting and carrying machinery in the shape of locomotive and overhead cranes and industrial cars, together with scrap and pig breakers. There is also the sprue breaker which simplifies considerably the handling of this awkward and bulky material. Ele-

vators to the charging floor usually come under the head of yard machinery, and here we have also the slag barrel and water barrel for preventing waste of material.

Attention is now being given to the saving of sand by rebonding processes in order to economize in raw material and in the disposal of waste, as in sand the binding material is but a small proportion of the entire mass and injury to this binding element which prevents its further usefulness results in the loss of disproportionately large quantities of the refractory portion of the mass.

The Foundry Building

The building which is to house the proper arrangement of apparatus is also a subject for engineering thought. The first consideration, of course, is that the full possibilities of the arrangement of the apparatus and operations shall be developed. Care should be exercised to prevent the manufacture of anything that might be an obstacle to the development of any particular function, that is, the building should be of such type of construction that changes in its form, openings, etc., may readily be made. The march of improvement is so rapid in this country that it is impossible to predict how often the manner of turning out products will be changed. The building, therefore, must be adaptable.

I personally prefer brick and steel construction to any other and have had no reason to alter this opinion after considerable experience in building this type of manufacturing plant. Where much machinery is used, especially conveying machinery, it often develops that instead of using subgrade construction, an advantage, both in first cost and operation, is gained by making the building of more than one story. This has led to the so-called two-story foundry, which is in successful use where the quantity of production is great and the use of machinery extensive. Co-existent with the foregoing considerations are those of proper lighting, ventilation, heating, etc., that the human machine may operate in freedom from mental or bodily discomfort, thus securing the utmost which it is reasonable to expect from human endurance. The construction itself calls for careful study that wear and tear from usage and the elements shall be properly attained without too great a first cost.

Among the elements to which the structure is most subject to attack is fire; principally from the inside on account of the nature of the occupation and somewhat from the outside, by reason of the proximity of other structures. There are available the sprinkler, the metal window sash, wire glass and the tile roof to minimize this source of loss. They are big dividend payers to the foundryman.

Permanent Molds

A considerable economy is to be attained in operation in the present state of the foundry business by the use of the well-recognized principles of subdivision and application of machinery and power. From a 50 per cent. productivity in the case of labor not subdivided and little or no machinery, to 75 per cent. to be attained where these principles are most fully applied, represents a saving of 50 per cent.

A productivity of 75 per cent. is, in my belief, about the limit that can be reached in the foundry art with such operations as are necessary at this time. There may be, of course, individual instances which will exceed this, but the figure refers to the average. It may be that we shall find in the permanent mold a method which will considerably increase the relative productivity of the labor. Time studies on repetition work to which the permanent mold would be applicable show that there is many times as much labor consumed in making the present mold by present methods as is used in pouring and shaking-out, while the material handled in the making of molds is frequently tenfold or more the weight of the castings produced. Also, there are several pieces of equipment to be handled in one casting or gate of castings. If the permanent mold could be developed these ratios would be cut down and less material as well as fewer parts would be handled. Of the 50 per cent. increase in productivity of the man, at present available, however, you can all secure a part. Some subdivision of labor and some mechanical apparatus is applicable to part or a whole of the operations in the jobbing shop and in the shop which handles a considerable range of standard work.

A mechanical engineer and manufacturer of world-wide reputation has said that "the achievement of a result regardless of cost is not engineering." Having this in mind,

it is essential to carefully study all conditions. In arriving at a practical conclusion as to the installation of machinery and the subdivision of labor, the cost of installation and operation and the possible increase of product must be considered as well as the increase of productiveness of labor.

We have been called upon to examine

cases where unintelligent application of mechanical devices materially diminished the productiveness of the labor in addition to entailing heavy expense in installation and operation. On the other hand, the highest productivity, and hence greatest economy in production, have been obtained where the apparatus and subdivision of labor have been most intelligently employed.

FROM AMBER TO DYNAMO

Part VII—Energy Relations

By H. E. Willmore, Jr., B. S.

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Stepping aside from our electrical textbook and the plating room for a moment let us consider the untechnical significance of such terms as "pressure," "resistance," "current," "work" and "power." They are all abstract terms and consequently lead to no definite mental pictures. When we say "pressure" we think of a force, and a force we know is that which will impart motion to a body. A number of little bodies in motion would constitute a current, and any opposition which they overcome is resistance. In moving these bodies through a distance and against the resistance which they encounter, the force does work. And the time rate at which this work is being done at any instant is the power.

These points are mentioned at this time to allay the fear that besets the student of electricity when he deals with terms for which he finds difficulty in forming mental pictures.

The applied voltage or electric potential difference is the force which causes the electrons to overcome the opposing resistance and move along the conductor. When these electrons move against resistance, work is done. The amount of work done in a given time depends upon the number of electrons moved and the electro-motive force (voltage) which overcomes the resistance. Now the ammeter measures the rate at which the electrons pass a given point in the circuit, the unit being one coulomb per second, or one ampere; and the voltmeter measures the electromotive force, or difference of

potential between the two points with which it is connected. With a steady flow of current, therefore, the product of the amperage, the time of duration of this current and the voltage between two points represents a definite amount of work which has been done between these two points where the voltage was measured. The electrical units of work have been chosen so as to bear out the simple relation of units. The relation between these units and the mechanical units has been quite accurately worked out. The small electrical unit of work, which is used largely in experimental electricity, is the amount of work done by one ampere flowing for one second between two points in a circuit having a difference of potential of one volt. A larger unit is also employed which is equal to a steady current of one ampere flowing for *one hour* between two points having a difference of potential of one volt. This unit is known as the "watt-hour." The time rate of doing the work (the power) is then the product of the value of the current in amperes and the simultaneous pressure in volts. The unit of power is the "watt" which is equal to the product of one ampere and one volt. 745.6 watts are equivalent to the mechanical horsepower.

One or two examples may lead to a better understanding of the units of work and power. Referring to Fig. 11 (Part VI) suppose that the electromotive force (difference of potential) supplied by the battery to the terminals P & N is 1.5 volts and

the current which flows along the wire O, through the miniature tank T and back to the terminal N is 10 amperes. If the voltage and current retain these values for one hour the work done in this part of the circuit is fifteen watt-hours: $1.5 \text{ volts} \times 10 \text{ amperes} \times 1 \text{ hour} = 15 \text{ watt-hours}$. If the same values of voltage and current obtain for one and one-half hours, the work done will be 22.5 watt-hours. These figures represent the amount of work expended in in that part of the circuit external to the battery, or they represent the amount of energy (work) supplied by the battery. The energy supplied by the battery is in turn the converted chemical energy of the cell minus the energy lost inside the cell. The average rate of doing work would, of course, be equal to the work

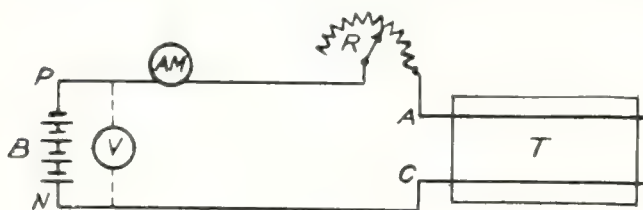


FIG. 13

done divided by the time it took to do the work. But by multiplying the instantaneous readings of the voltmeter and the ammeter we derive a similar result which is the instantaneous power or time rate of doing work in that part of the circuit included between the points where the voltage is measured. Referring to Fig. 13 suppose that the battery pressure as measured by the voltmeter was 6 volts and that the current measured at the same instant was 12 amperes. Then the power which was being delivered by the battery at that instant was 72 watts, and if it remained constant for one hour 72 watt-hours of work would be done.

The algebraic equations furnish us with a handy method of stating the above relations between current, voltage and energy or power delivered to any section of a circuit. The energy or work equation may be stated

$$W = E I T \quad (1)$$

in which W stands for the work measured in watt-hours, E the electromotive force in volts, I the current in amperes, and T the time in hours. Then by letting P stand for watts of power, the power equation may be written:

$$P = E I \quad (2)$$

As has been pointed out time does not enter into power. The instruments used for the direct measurement of energy and power delivered to any part of a circuit are known as the integrating or watt-hour meter and the watt-meter respectively. These instruments will be described later.

The distribution of energy throughout a circuit is of decided importance. If we were laying out a pipe line such as the one in Fig. 12 (Part VI) for connecting a turbine with a pump, we should expect to find some energy loss in the pump, the pipe and the turbine. It would, therefore, be very desirable for us to know something of the characteristics which determine the losses. Likewise it is very desirable for us to know something of the nature of the losses in the electrical circuit. Some of the energy delivered by the pump to the pipe line is lost in friction which heats up the pipe very slightly. Current passing through a wire produces a heat effect which, as a rule, is far more noticeable than the heating of a water pipe. This heat means converted energy. In Fig. 13 a certain amount of energy is lost in the wire connecting the terminal P of the battery to the ammeter and the ammeter to the arm of the rheostat R. (The loss in the ammeter in most cases is so small as to be negligible.) The magnitude of the loss in this wire depends upon the total resistance of the wire, the magnitude of the current, and the length of time that the current is flowing. Joule's law gives the relationship: "The amount of heat generated in a given wire is proportional to the square of current flowing in the wire and to the time that the current continues to flow." The exact proportion is represented by the resistance which is constant for any one wire. If the time is measured in seconds, the energy expended in joules of heat is equal to the product of the resistance in ohms, the time in seconds, and the current taken twice as a factor. This can be stated: $H = R I^2 t$. If the time is measured in hours the energy loss is measured in watt-hours,—

$$W = R I^2 T \quad (3)$$

The energy loss in watt-hours of heat is equal to the ohms resistance of the wire times the number of amperes of current squared, times the time in hours. The power in watts representing this lost work can be shown to be equal to the resistance in ohms multiplied twice by the current in

amperes or is equal to the voltage drop multiplied by the current:

$$P = R I^2 = EI \quad (4)$$

It is interesting to note the relation between equation (3), Ohms law and the equation (1) previously given for the work delivered to any part of a circuit. If we connect a voltmeter between the points P and R (Fig. 13) we would find a small difference of potential. Then according to equation (1) the watt-hours used in this part of the circuit

in these parts of the circuit is 36 watts. If the pressure of the battery is 6 volts as before, the power that is delivered to the tank is 72 watts minus the 36 lost or 36 watts. The power supplied to the tank is partly used up in heat due to the electrolyte resistance and the remainder is converted into chemical energy. A similar loss takes place in batteries.

The measure of power indicates the distribution of work along the path of a simple

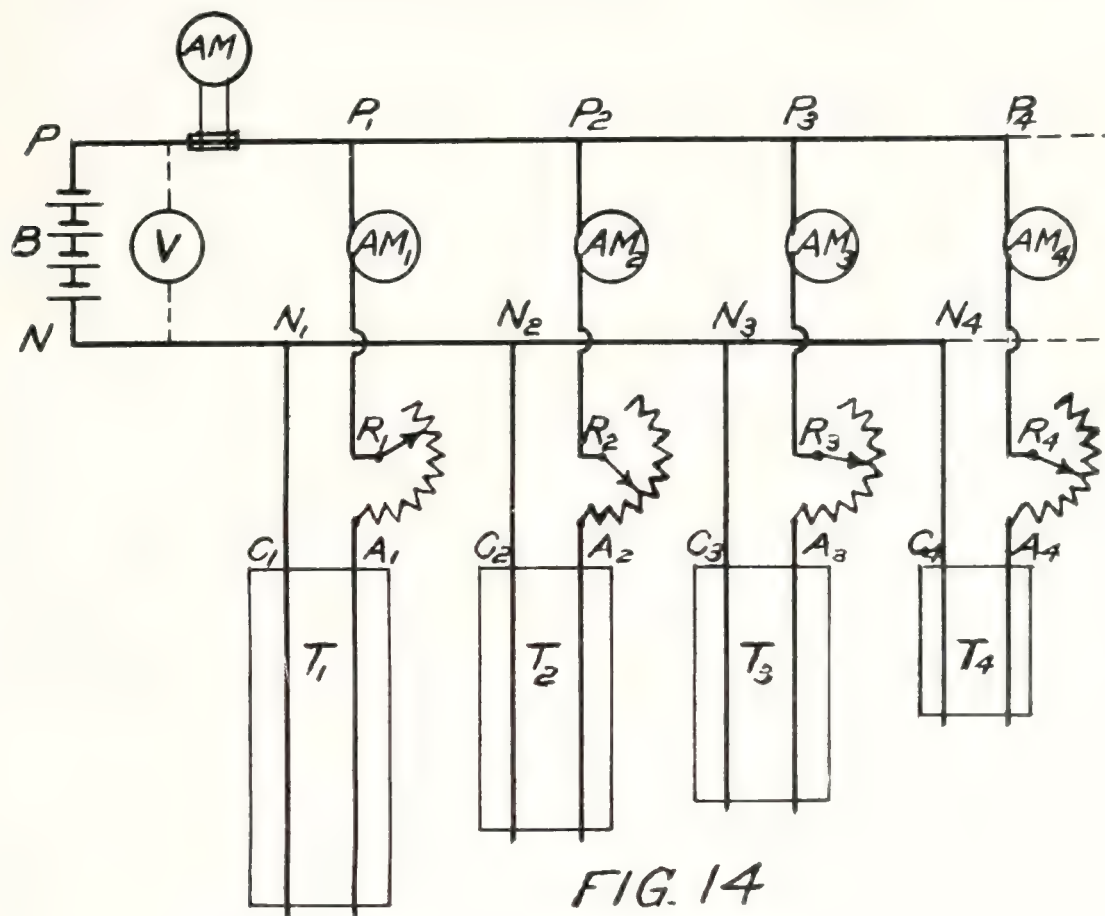


FIG. 14

would be given by $W = E I T$. Now the watt-hours used must be the watt-hours lost in this case, hence

$$W = E I T = R I^2 T$$

$$\text{or} \quad E = R I$$

This last equation is one form of Ohm's law (see Part VI) which states that the voltage drop between P and R is equal to the resistance of the wire in ohms multiplied by the current in amperes.

In analyzing the other parts of the circuit it will only be necessary to consider the power relations, remembering that the work is equal to the power multiplied by the time. Power losses exactly similar to those in the wire PR take place in the rheostat, tank rods, anodes, cathodes, and the wire CN. If the total resistance of the two wires and the rheostat is .25 ohm and the current flowing is 12 amperes, then the power losses

or series circuit. In dealing with complex circuits (branched or multiple circuits) the same is true for each branch or loop. The notable difference between series and multiple circuits (Fig. 13 and Fig. 14) lies in the fact that in the former all the electrons leaving the source of potential follow a single path, while in the latter the electrons may be divided over a number of paths. In all cases the number of electrons returning to the source of potential must be equal to the number being sent out. This means that everywhere along a single electrical path the current must be the same. Hence the statement is often made that the current is the same at all points in a series circuit. The ammeter could be placed at any point in the circuit of Fig. 13 and it would indicate the rate of flow throughout the circuit. This is not true for the circuit of Fig.

14. The ammeter in the main bus indicates the total current set up by the battery or dynamo, but this ammeter must be placed somewhere between the source of potential and the first branching point of the circuit, —between P & P_1 or between N_1 and N . If placed between P_1 & P_2 or between N_1 & N_2 it would indicate the current flowing through the tanks $T_2 + T_3 + T_4$ etc. Ammeters 1, 2, 3, & 4 alone indicate the current of their respective tanks. The sum of their reading will equal the reading of the main ammeter. The reading of ammeter 1 times the voltage measured between the anode and cathode rods gives the power being used by the tank.

In the same manner that the power indicates the distribution of energy throughout a circuit the voltage drop may be shown to indicate the power distribution along a series circuit or a single branch of a multiple circuit. Considered as a mathematical problem, I in the equation $P = EI$ becomes a constant and P is proportional to E . Interpreted this means that the voltage measured between any two points when compared to the total voltage impressed upon the path gives the proportion of power,—and hence the proportion of work—used in that part of the path over which the voltage was measured. For example suppose we connected the voltmeter to P_2 and N_2 and found that it read 5.5 volts. If at the same time the voltage between A_2 and C_2 was found to be 4.4 volts, the plating tank would be using only four-fifths of the power supplied to the branch P_2, A_2, C_2, N_2 . The other fifth of the power is used up in the rheostat R_2 and the wires P_2, A_2 and C_2, N_2 . If a voltage reading is taken across the terminals of the rheostat, the proportion of power used up in this part of the circuit can be found. These voltage readings are also indications of the proportionate resistance of various parts of a series circuit. The value of the resistance in ohms can be found by dividing the voltmeter reading by the ammeter reading. With an approximately constant voltage as is delivered by a dynamo the amount of current passing through a series circuit or branch depends upon the total opposition offered by the circuit. For the present let us consider this opposition entirely made up of resistance. Since we have shown that the distribution of power is proportional to voltage differences throughout a series circuit, it is but an-

other step to show that the voltage drop over any part of the circuit is to the total drop as the resistance of that part is to the total resistance. This is true because the voltage drop is equal to the resistance times the current, and the current is the same at all points in the series circuit.

Core Compounds

The considerations in selecting core compounds are treated of with intelligent discrimination by the writer using the pen-name of Melter, in a recent issue of Canadian Foundryman. His conclusions follow:

Conditions under which core compounds are selected do not appear altogether satisfactory, either from the standpoint of consumer or from that of the producer. This, however, is not surprising as the materials involved differ greatly in composition and are subject to varied applications.

Cores are of two kinds—green sand and dry sand. Those of the former will not be considered here, as they do not require compounds to create binding power, but rely altogether on the shape of the grains of sand.

The Sand Feature

The suitability of a core for any special line of work depends largely on the nature of the sand and binder mixed with it. The chemical composition, the degree of fineness and shape of grains of sand are all-important factors. A sand high in alumina will bake harder than one with a smaller percentage of alumina and the harder condition would be detrimental to good venting. The coarser the sand, other things being equal, the greater will be the strength, at least up to a certain limit.

Organic matter gives bond, but burns out when molten metal comes into contact with it, causing the core to fall or crumble. For this reason, river sands are better than bank sands, as all foreign matter is washed out. Iron, manganese, magnesia and lime are all detrimental, and have the effect of causing the core to crumble as already noted.

A medium coarse grade of sand should be used, say, with a degree of fineness of from 55 to 75. A grade coarser than this does not permit of its voids being all filled

by the binder, and the result is a weak core. For instance, a 35 grade sand when new was 40 per cent. weaker, comparatively, when mixed with the same proportion of compound, sand and clay wash, and baked for the same length of time and at the same temperature as a 50 grade sand. The degree of fineness of a sand may be found from a sieving test by multiplying separately the number of grains passing through each sieve by its mesh number, adding the results and dividing the whole by 100. Sieve meshes of 100, 80, 60, 40 and 20 are used.

The most convenient way is to weigh out exactly 100 grains of sand, sift for one minute on the 100 mesh sieve, weigh what goes through, sift the balance on the 80 mesh sieve for one minute, and so on. Any loss is counted on the 60 mesh, and what does not go through the 20 mesh is credited to the one mesh sieve. If the sand is very fine, more binder will be required and a close hard core with poor venting will result. It is possible to use 85 per cent. old and only 15 per cent. new sand and get good satisfaction. If machine mixing is practical more old sand can be used than when mixing is done by hand.

It is not beneficial, however, to run up old sand much beyond 85 per cent. Used sand has the alumina (clay) burned out, and each grain of silica has a coating or film of carbon around it. This film of carbon does not permit the binding material to be as effective as it would be if new sand were employed. If there is much fine sand in the old, more binder will be required, as the dust needs as much binder as is necessary for the grains.

Core Binders

Core binders may be divided into four groups—dry compounds, oil, paste, and those which are capable of being dissolved in water.

Flour is a paste binder. It burns out easily and is, therefore, good for long thin work, although it has very little green binding power. The core should be used almost immediately, as moisture is taken up from the air and molds.

When using flour, a good brand should be had, as it is the starch and gluten which give binding power. Poor grades of flour are yellow, mealy and oily because they contain bran. They are high in fiber, fats

and ash and create more gas. Tests have shown that a flour containing 50 per cent. less crude fiber, fat and mineral matter had 65 per cent. more strength than the inferior product, and 25 per cent. less flour was required to obtain equal strength which result would more than counteract the difference in cost. It has been found that some flours are adulterated with as much as 40 per cent. mineral matter. This should not be over 1 1-3 per cent. Fat, on the other hand, should not exceed 2½ per cent., and fibre 1¼ per cent.

A simple test of further difference invisible to the naked eye is to spread out on a piece of glass a small portion when the yellow color is easily seen. Another way of testing is to mix a little dough and try for toughness and dryness. A strong flour is shown by its readiness to absorb water, and make a clean dough that shows tenacity when pulled out. This result will be accentuated if the dough is left exposed for a short time before trying. If, in working, it is still sticky, the flour is not so good, but if it break short it is undoubtedly inferior.

Oil binders are made from linseed, fish, mineral oils and resin. Clay absorbs oil and therefore it is not beneficial to mix the two. Oils and gums flow through the sand and get in between the particles, while flour, resin and starch do not, but just bind adjacent grains. This segregation of binder causes an excess of gas at the point of segregation. Oil cores have very little green binding power, though they are better than paste or dry binders. Oils containing mineral oil need longer to bake because the mineral adulterant must be volatilized before gums or pitches act.

Dry compounds are made up of resin, pitch, dextrin, coke dust, and sometimes a little sawdust is added to facilitate removal from the casting. Dextrin is a green binder which is soluble in water and therefore flows to the contact points of grains of sand, when there is sufficient moisture added. Resin will not stand a high heat when baking, as it melts at from 100 to 140 C. It is not soluble in water and has no green binding power. Pitch when in contact with molten iron forms coke which will not clean out.

Binders which are dissolved by water are molasses, sour beer, glue and the by-product of the sulphite paper industry.

The latter is very plentiful in Quebec Province, is strong, cheap, a good green binder, and can be used with clay wash or mixed efficiently with any other binder. It is composed of gums and resinous liquors which flow through the sand, giving contact at all points.

Testing Compounds

In testing compounds, the relative cost per pound should be figured and a set of test cores made with constant quantities of new and old sand. The amount of compound should vary so that each set of cores costs the same amount. A convenient core box is a mold used for cement testing, and having enlarged ends for gripping in the test machine, while the area on which the load is applied is exactly one square inch. Some people prefer to use test cores 2 ins. square by 13 ins. long, and test transversely on 12 ins. centers. It is immaterial, however, what size bar is employed.

Cores are examined for green binding power, change of shape, time of drying, appearance of exterior and interior, and strength. In recent tests, some cores even made of new molding sand had a degree of fineness of about 55. These were 300 per cent. weaker than when made from the same old molding sand having the same degree of fineness.

Another set of cores were made from new core sand with a degree of fineness of 35, and these cores were very much weaker than anything tested. The latter result was possibly due to the voids being too large in proportion to the quantity of compound used. The two tests confirm, however, that it is necessary to have a sand carefully selected as to size, shape of grains and freedom from vegetable matter.

We found also that the by-product from the paper industry (sulphite process) could be used in the proportion of 55 sand to 1 binder with the same amount of clay wash as the latter; that it was 130 per cent. stronger than the cheapest oil tested; 150 per cent. stronger than the two dry black compounds tested, and about 140 per cent. stronger than flour. All were mixed with a constant quantity of the same sand, placed in the oven at the same time, and given the same degree of heat for the same period. The amount of binder, however, was varied in quantity according to the cost, so that all cores required the same

amount of financial outlay. A number of the compounds tested contained the following substances:—

Black Compound.—Pitch, coal, resin, sawdust.

Oil Binder.—Dynamo oil, linseed oil.

Paper Industry By-Product.—Gum resin, dextrin, pitch, sour beer.

Although the dollars and cents savings on the adopted practice over that recommended are not apparently very large, when taken in conjunction with the better casting features, there is to be noted a quite appreciable over-all benefit.

The costs were based on:—

New core sand at \$1.60 ton net.

Blue clay at \$1 ton net.

Old compound at \$1.87 per lb.

New compound at \$1.17 per lb.

	Old Mixture.		New Mixture.	
	Lbs.		Lbs.	
Old sand	315		375	
New sand	105	60.063	63	00.037
Compound	14	26.18	8.4	9.828
Clay	10	.05	8	.400
		26.293		10.265

This shows a difference of 16.028 cents on 420 lbs. of sand in favor of the new mixture, and as there was a monthly consumption of 22,000 lbs. of new sand, a saving of \$8.38 was effected.

McLain's System

Mr. D. McLain, of Milwaukee, is the originator of McLain's System, and as our readers are interested in anything relating to foundry practice, we believe the following information regarding McLain's System will be of interest.

Mr. McLain has issued an interesting booklet describing the system and we understand that copies of it will be sent to any interested parties on application. This system consists of 12 printed lessons, giving complete information and instructions regarding grey iron mixtures, the best cupola practice and the making of semi-steel.

It also includes a great many money-saving ideas, facts and figures, which are the result of the writer's 35 years' actual practical experience in the metallurgy of iron and scientific melting while employed as molder, foreman, superintendent, manager and systematizer of foundries.

The booklet gives in concise form the fundamental rules and instructions on successful mixing and melting of iron and steel

scrap and the practical application of this knowledge to the student's line of work. Every point that confronts the foundryman—every trouble that causes defective work is explained and also the way to avoid it.

All the troubles due to poor coke or excessive coke—the reasons for slow melting, dull iron, dirty iron, bridging, etc.; why castings have blow holes, hard spots, porous and spongy parts, internal shrinkage, pitted surfaces, are cold short, or brittle, etc., and particularly how to get rid of these defects when they occur.

Why many small castings crack in the mold, why thin ones won't run, why many light ones are too hard or too soft, and heavy ones spongy and weak, and the remedy for each case, is fully explained. How to avoid leaky, porous, or open-grained cylinders or other castings that fail on tests—how to secure a denser, closer metal—in many cases testing up to 3,000 lbs. water pressure is also included.

These instructions also show how to reduce section without reducing strength, and when strength specifications cannot be met—how to increase tensile and transverse from 20 to 50 per cent. above that of grey iron. Also how to save lining from burning out too quickly—how to keep slag fluid—how to avoid getting excessive sulphur from the fuel—how to increase total carbon if too low, and remedy the troubles due to blast conditions.

In fact, no point on the best practice is omitted. All instructions are in simple foundry language. The student is told exactly what to do, and the advice is applicable to all shops. No new equipment, special appliances, dopes or fluxes are needed.

Every bit of information is backed by actual experience, has been proven correct hundreds of times, in shops of every kind in all parts of the world and making every class of work.

It is claimed that the McLain System will enable a foundryman to make better castings, whether grey iron or semi-steel—to use 10 to 50 per cent. steel scrap and lower silicon irons, thus cheapening mixtures—to cut out use of charcoal or high silicon pig—to reduce losses to 1 to 2 per cent.—to make semi-steel castings that are cleaner, stronger and that sell for more than grey iron, and all of this is accomplished without any additional equipment.

Any one interested in the above subject should write to McLain's System, 905 Goldsmith Building, Milwaukee, Wis., for "A Synopsis of McLain's System."

Book On Bells

Meneely & Company have published a "Book On Bells" that is a comprehensive account of bells, practical, curious and historic. The illustrations add to the interest. Much of the information will be new to readers, as it is from a source that it is quite fair to say is the very last word on all that pertains to bells.

John Wiley & Sons, Inc., New York, announce as ready the second edition, revised, of "Experiments in Organic Chemistry," also "A Laboratory Manual Design" to accompany "Outlines of Organic Chemistry."

The west coast of South America has materially increased its exports of copper, especially to the United States. Pig copper from Chile and Peru arriving in the United States in the eight months ending with February amounted to 52,000,000 pounds, against 42,000,000 pounds in the same months of last year, and in February alone 11,000,000 pounds, against 7,000,000 pounds in February of last year. Of copper ore the arrivals from the west coast are chiefly from Chile and show a slight reduction when compared with last year. The United States, although by far the largest copper producer of the world, is also a large importer, the total value of copper imports in 1914 having been practically \$55,000,000, against \$22,000,000 in 1904, having thus increased about 150 per cent. in the decade.

Statement of the ownership, management, circulation, etc., of BRASS WORLD & PLATERS' GUIDE, published monthly at New York, N. Y., required by Act of August 24, 1912.

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There are no bondholders, mortgagees or other security holders.

C. N. MANFRED.

Sworn to and subscribed before me this 15th day of June, 1915.

(SEAL)

ELLA L. BOWERS.

Notary Public, New York County, No. 185.

Commission expires March 30, 1917.

Trade Notes

The Wray Fresh Water Supply Company, Kewanee, Ill., has acquired the machine shop equipment and the Kewanee Brass Foundry Company, the foundry formerly owned by Hedburg Brothers. A new brass furnace is to be installed.

The R. C. Staples Chemical Company, Ft. Smith, Ark., has been incorporated with a capital stock of \$50,000 by R. C. Staples, D. C. Goff, J. S. Harper and George F. Youmans.

The Carbo-Hydrogen Company, Dover, Del., has been incorporated with a capital stock of \$3,500,000, to manufacture carbo-hydrogen and similar products and blow-pipes for cutting and welding purposes. The incorporators are J. R. Rose, Pittsburgh, Pa.; Herbert E. Latter and Norman P. Coffin, Wilmington, Del., and Clement M. Egner, Elkton, Md.

The Engberg's Electric & Mechanical Co., St. Joseph, Mich., contemplates erecting a foundry and machine shop at a cost of \$20,000.

The Miami Brass Foundry Company, Dayton, Ohio, has commenced work on an addition to its plant, 40 x 70 ft., one story, of brick construction. Some foundry equipment will be required.

The Art Wares Mfg. Company, Indianapolis, has changed its articles of incorporation to provide for \$10,000 capital stock.

The plant of the Troy Foundry Company, Troy, Ohio, has been purchased from the receiver by W. T. Anglemeyer, A. E. Lockwood and John Lust.

The Brown Metallic Products Company, Detroit, has been incorporated with \$10,000 capital stock to manufacture metal specialties. The incorporators are R. Harry Brown, Claytice W. Brown and G. Edwin Chamberlain.

To care for the sulphuric acid order from the Du Pont de Nemours Powder Company, amounting to about \$1,000,000, the Davison Chemical Company, Hawkins Point, Md., will make improvements to cost between \$100,000 and \$150,000.

The Art Metal Products Company, 514 South Green Street, Chicago, has increased its capital stock from \$20,000 to \$50,000.

The Curtis Platinum Aluminum Co., Inc., Buffalo, has been incorporated with \$50,000 capital to engage in the manufacture of

castings and plated work. The incorporators are Gerald O. Curtis, DeWitt Clinton and Albert C. Towne.

The Taunton-New Bedford Copper Company, New Bedford and Taunton, Mass., has secured a building permit for a large addition to its Taunton plant, and the work of construction has already begun.

The Coopersburg Casket Company, Coopersburg, Pa., has been incorporated to continue the present business under the same name. The capital stock is \$30,000.

The Casting Temperature of Metals

The following opinions regarding the proper temperature at which alloys of copper should be poured were expressed by members of the London branch of the British Foundrymen's Association at a recent meeting. One member contended that the size and thickness of the casting should govern the temperature at which the metal should be cast; another stated his opinion that a comparatively wide range was covered; that castings need not to be poured at any one particular temperature but that a range of as much as 25 deg. C. on either side of a given point was perfectly permissible.

E. M. Boote agreed that there was a considerable range but that it was not good practice to heat the metal to a high temperature and then cool down just before pouring the molds. For example, suppose the metal is heated to 1200 deg. C. and then cooled to 1050 deg. C. to pour, bad results could be anticipated. F. G. Chambers remarked that he always judged the pouring temperature by the eye. With manganese bronze, he continued, the metal should be heated until the zinc fumes flared, the pot then pulled out of the fire and after being skimmed should be poured when the zinc flare ceased while the metal surface was undisturbed, but resumed flaring on pouring. In the case of ordinary bronze the metal should be poured when a skin formed from the side of the pot across the metal. F. C. Barker stated that the gun metal 88-10-2 should not be overheated, but if poured too cool it lacked strength. He ascertained the pouring temperature by pushing the charcoal back a little and observing the surface of the metal. When rainbow colors showed across the exposed surface the metal was ready for pouring.

TRADE OPPORTUNITIES

The names and addresses of subscribers who have sent in any of the following inquiries will be furnished to any of our advertisers on application. In writing it is only necessary to give the serial number of the inquiry.

Inquiry No. 1—Tumbling Barrels

Can you give me any information or the address of any concern handling tumbling barrels for tumbling small brass castings that will run about six to eight castings to a pound?

I understand that some concerns are tumbling such castings with steel balls and some kind of a solution long enough so that it practically eliminates buffing and polishing, and take them direct from the tumbling barrel to the plating room.

Any information you can give me on this subject will be appreciated.

Inquiry No. 2—Dust Collectors

We wish to inquire if it is common practice for factories finishing brass to use one of the so-called dust collectors? If so do they usually separate the brass finishing and the iron finishing? Do they have a different collector for the exhaust from rag wheels and finishing wheels? Is this material of much value to be sold for copper contents?

Inquiry No. 3—Spraying Hot Metal

Some few months ago the writer saw an advertisement of a method of plating by spraying hot metal on surfaces. Can you let me know how we could get in touch with such methods if there are any?

Inquiry No. 4—Crucibles—Buff Wheels

We will be pleased to have you advise us if you know who buys old broken crucibles. Also pieced buff wheels worn down to about 7 to 8 inches in diameter.

Inquiry No. 5—Clarifying Scrap Brass

As a subscriber to your journal, I am seeking a little information, and enclose a stamp for your answer.

The brass foundry where I work has always used all new metals, but since the war prices for copper, tin and spelter have come in they are trying to use some scrap brass.

Their castings must be made close grained as they are used on hydraulic work, and they must be able to withstand a water pressure of at least 100 pounds.

What do you recommend to be used with scrap brass for the purpose of clarifying

and purifying the metal so as to make it suitable for the above use?

We have had recommended to us both phosphor tin and phosphor copper and would like your advice on either or both, or do you know of anything better? Which would cause the greater shrinkage in the metal?

Would it be advisable to remelt this scrap into pigs and then use it, or could just as good results be obtained by putting this scrap in with some new metal and melting all down together?

Inquiry No. 6—Bronze Foundry

We have always bought our castings, which are of bronze and small pieces weighing from $\frac{1}{4}$ pound to 5 or 6 pounds, and have been considering whether there would be any advantage in putting in a foundry department of our own. Our requirements last year covered between ten and twelve tons of these castings, and we would be glad to have from you an opinion in regard to this. We should also be glad to receive any suggestions in regard to equipment, etc.

Inquiry No. 7—Brass Castings in Metal Molds

To your knowledge is there any one in this country making brass castings in metal molds?

Inquiry No. 8—Black Oxidation Process

Recently we received pamphlets of a quick dripping black oxidation process. It would seem as though this oxidation was made in Switzerland by Henry Rychner, and one of the pamphlets stated that samples would be furnished on application, but we mislaid this so we do not know to what address to send for samples.

As we do not know whether there is an agency in this country or whether we shall have to send direct for these samples, we would ask you to kindly advise us if there is an agency here from whom we can procure samples at once.

Inquiry No. 9—Sand Crucible

We would be pleased to have you refer us to a few manufacturers of sand crucibles as we are in the market for same.

CLASSIFIED ADVERTISEMENTS

Advertisements for Help Wanted or Situations Wanted published free of charge. Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars. If in display type—two dollars per inch, each insertion.

Help Wanted

ENAMELING EXPERT—A man thoroughly familiar with sanitary baking enamels and with methods of applying them by dip or spray process to articles after they are formed. In answering state age, whether married or single, least salary expected, and references. Address "B C" care of Brass World, Edison Bldg., New York.

WANTED—Foreman for brass foundry, manufacturing a line of small work similar to builders' hardware, padlocks, etc. Must be a hustler, progressive and up to date and be able to furnish A-1 references. In replying give a full and detailed account of past experience, places previously employed and length of service, age, nationality and wages expected. Address "E. M. O.," care of Brass World, Edison Bldg., New York.

Situation Wanted

POLISHER, BUFFER AND PLATER—First class as all three. Want to make change. Prefer Chicago, New York or its suburbs. Address "CAPABLE" care Brass World, Edison Bldg., New York.

PLATER, POLISHER and BUFFER—Wide experience, desires position where executive ability is required. Have made and used all known solutions on any line of work. Installing plants, and introducing efficient systems for day or piece work a specialty. Address "Experience," care Brass World, Edison Bldg., New York.

ELECTROCHEMIST—Graduate Toronto University, varied experience in analysis, research, manufacturing and factory costs department. Employed for past year by one of the largest silverware factories in Canada. Especially familiar with non-ferrous alloys and electro-plating. Have

a process by which flatware can be plated and sectional plated, both in one operation. Address "ELECTRO," care Brass World, Edison Bldg., New York.

FOREMAN PLATER—Nickel-plating, polishing and buffing departments. At present in charge of these departments, but wish to make change. Twenty-five years' experience. Can furnish best references; sober and reliable. Address "COMPE-TENT," care Brass World, Edison Bldg., New York.

FOREMAN PLATER—18 years' experience as practical, all-around man. Can make and take care of all solutions, also make all dips, stains, and bronze finishes of any shade. Toning of metals to match sample of any color. Experienced on lighting fixtures, lamps, trunk hardware, hollow ware and architectural bronze work. Position in Greater New York preferred. Address "PRACTICAL PLATER," care Brass World, Edison Bldg., New York.

POLISHING—This one thing I know. Have made many labor-saving devices, reducing cost over one-half, at same time doing better work. Are used in present position. Twenty years spent in studying and producing results. High references. Address "POLISHER," care Brass World, Edison Bldg., New York.

FOREMAN PLATER—Experienced man can take charge of polishing and buffing; has good reference from last place, where I had charge of the plating department in fancy brass goods. Experienced on such goods as chafing dishes, percolators and electro tin, also silver plating. Address "CHAPIN," care Brass World, Edison Bldg., New York.

The Brass World & Platers' Guide

Volume XI
Number 7



New York
July, 1915

A Monthly Journal Devoted to the Art of Refining, Alloying, Casting, Rolling Founding and Electroplating of All the Non-Ferrous Metals and their Alloys

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Peculiarities of Manganese and Iron

The statement is frequently made that manganese is used in manganese bronze because it acts as a "carrier" of the iron that frequently also forms one of the constituents of this alloy. This means that the manganese carries the iron into solution in the copper, for as is well known iron does not always alloy, but is frequently found distributed in brass and bronze in the form of small pellets of extreme hardness that work havoc with the tools used in machining the castings.

The hypothesis has been evolved, therefore, that the presence of some third element is necessary in alloys of copper and iron, to ensure the solubility of the latter in the copper. There is no fault to be found with this belief for while such a medium has been proved unnecessary, still in ordinary practice it is very convenient to use such a "carrier" whenever possible in making alloys of iron and copper.

The thing that is difficult to see is why manganese should act in this capacity, for while it alloys readily with both copper and iron this fact is not justification for the belief that it will cause these metals to unite, in fact, there is every reason to believe that manganese would exert an opposite effect, and instead of carrying the iron into solution would cause it to separate from the copper.

The evidence is strongly in favor of this last theory, for if an alloy of copper and manganese is made by melting together ferro-manganese and copper, a large portion of the iron can be removed by simply casting the alloy in sand ingots, so that it can cool slowly. A rich iron manganese alloy containing a little copper will solidify and rise to the upper part of the ingot whence it can be removed before solidification of the ingot.

It would be better therefore, to regard manganese as a deoxidizer, and its office strictly that of a purifier of manganese bronze, when it exists in the small quantities that are sometimes found in that alloy and not as a carrier of the iron, for if it did act as a carrier it would be perfectly feasible to make manganese bronzes by alloying ferro-manganese and copper, in the proportion of 15 to 20 per cent manganese, balance copper, iron, zinc or lead according to the requirements demanded of the alloy. This would be a cheap way of

making some very serviceable alloys, but is not practicable because of the iron, which instead of being dissolved, exists as intensely hard nodules in the alloys.

The proper carriers to use when alloying iron and copper, are silicon and aluminum, as much as 10 per cent iron is frequently used in aluminum bronzes and the metal is perfectly homogeneous to the eye, and entirely free from particles of unalloyed iron, and silicon has a similar effect to aluminum in this respect. When iron is alloyed with copper in quantity without the intervention of some third element, it is necessary to use iron of great purity as regards carbon, in conjunction with very high temperatures to insure thorough liquifaction of the iron.

Thomas D. West

The death of Thomas D. West has removed another, and one of the last of the little coterie of writers and workers, to whose efforts is largely due the modern development, educational and otherwise, of the foundry industry. Mr. West was one of the earliest writers on foundry practice, his first article appearing in the *American Machinist* forty-four years ago. Since that time he has been an indefatigable writer on foundry and kindred topics. Some of his earlier articles were incorporated in his first book entitled "American Foundry Practice," now in its twelfth edition. This was followed by the "Molder's Text Book" and the "Metallurgy of Cast Iron." While most of Mr. West's articles treated of cast iron, on which subject he was a recognized authority, the non-ferrous field was not entirely neglected by him, for in 1886 he presented a paper on "Casting Aluminum Bronze and Other Strong Metals" before the American Society of Mechanical Engineers, of which he was a member. This was probably the first article ever published on the subject of aluminum bronze, and covers the molding and casting of this difficult alloy so thoroughly that the suggestions he makes are just as applicable to-day as when they were written, thirty years ago.

Mr. West lost his life as the result of an accident. He was struck by an automobile as he was crossing the street near his home at 10511 Pasadena Avenue, Cleveland, Ohio, the evening of June 17, 1915, and died the following day at Glenville Hospital. In this connection it is a singular co-

incidence that another noted writer on foundry subjects, Simpson Bolland, author of "The Iron Founder" and "The Encyclopedia of Founding," also lost his life as a result of an accident, being struck by a train as he was crossing the tracks.

A great change has taken place in foundry practice since Mr. West commenced his career in 1871 and in which he took an active part. In those days, foundry operations were usually conducted in dirty dismal shacks, absolutely devoid of all provision for the comfort of the workers, who froze in winter, roasted in summer, and stumbled around with the molten metal in the dark in the days when the natural light failed early, as no arrangements, other than the most crude, were considered necessary for light and heat. Brass foundries may have been a little better off in some respects than iron foundries, but that was because brass is a more costly metal than iron and could not be safely left lying around loose in wooden shacks. Ventilation, however, was lacking, pots were "pulled," carried off, and poured by muscular power, and toilet, locker, and mess rooms and other sanitary conveniences were undreamed of.

To the efforts of such thinkers as West, Bolland, Penton, Keep, Outerbridge, Sperry, Loudon, Ramp, and Shed, the foundry fraternity owes a debt of gratitude, and we suggest that measures be adopted of perpetuating their names and works in a foundry "Hall of Fame."

New Dutiable Status of Aluminum

The Treasury Department has instructed the Collector of Customs in New York of the department's findings that put aluminum on a new duty basis. We quote: "It appears that certain aluminum in sheets has been classified as dutiable at 3½ cents per pound under paragraph 143 of the tariff act, while certain aluminum blanks and foils have been returned as aluminum cut to size, dutiable at the rate of 20 per centum ad valorem as a manufacture of aluminum under paragraph 167 of the tariff act, following T. D. 33479. It appears further that certain items invoiced as foil of random lengths have been returned as aluminum in strips, dutiable at the rate of 3½ cents per pound under paragraph 143 of the tariff act.

"In T. D. 17058 the Board of General Appraisers found certain zinc foil and a foil of which copper was the component material of chief value to be in fact foil and so known commercially and held them to be dutiable as manufactures of metal rather than as, respectively zinc in sheets not polished nor further advanced than rolled, and copper in sheets, under the tariff act of 1894. In T. D. 2674 certain gold foil as contra-distinguished from gold leaf, was held by the department to be dutiable as articles made of gold.

"In view of these decisions the department is of the opinion that aluminum in the form of sheets or strips, even though not cut to size, if in fact foil, is subject to duty as a manufacture of aluminum. For the purposes of such classification you will consider aluminum in the form of either sheets or strips, not more than 0.0015 of an inch and not less than 0.0003 of an inch in thickness as foil and will assess duty on such merchandise imported or withdrawn from warehouse thirty days from the date hereof at the rate of 20 per centum ad valorem as a manufacture of aluminum under paragraph 167 of the tariff act of Oct. 3, 1913."

As a graceful compliment to Mr. Vickers, and as an approval of our judgment in selecting our staff, it gives the management of THE BRASS WORLD pleasure to quote from a recent letter from one of our subscribers. It runs:

"I note in one of your issues that you have engaged the services of Mr. Charles Vickers, and I congratulate you on this fortunate connection. Mr. Vickers, I believe, is the best in this line either in this or any other country, and best of all he is a likable chap, absolutely on the level, and a friend to every deserving foundryman. I congratulate both of you."

The Opinion of an Expert

Oscar A. Hillman of Attleboro, Mass., one of the acknowledged plating experts, says: "It gives me great pleasure to state that I consider the new BRASS WORLD better than ever before, and sincerely hope you will always be able to give us platers such practical and valuable articles as you have so far."

The Corrosion of Brass

By CECIL H. DESCH, D. Sc., Ph.D.*

The method usually employed to determine the relative corrodibility of metals and alloys consists in exposing specimens of the materials to be compared to the action of a corrosive agent for a sufficient time, and determining the weight in each case. The corrosive agent employed may be identically the same as the material would be exposed to when in service, such as atmospheric air, fresh or salt water, sewage or industrial liquors, or it may be an artificial solution, selected with the object of accelerating the test. In the latter case an external electromotive force is sometimes employed.

It is difficult to obtain accurate information in this way. The test of exposure to actual working conditions is so slow as frequently to be impractical, while most forms of accelerated test fail to indicate in any

pheric influences is by no means identical with that of the resistance to attack by dilute sulphuric acid, and a determination of the loss of weight under the latter conditions is valueless, and is generally recognized as being so, when it is desired to compare steels with a view to their use in external work. A similar statement may be

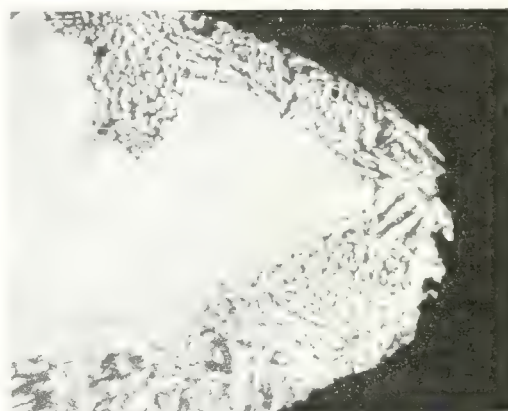


Fig. 2—How Corrosion Proceeds in Sea Water
Magnified 50 Diameters

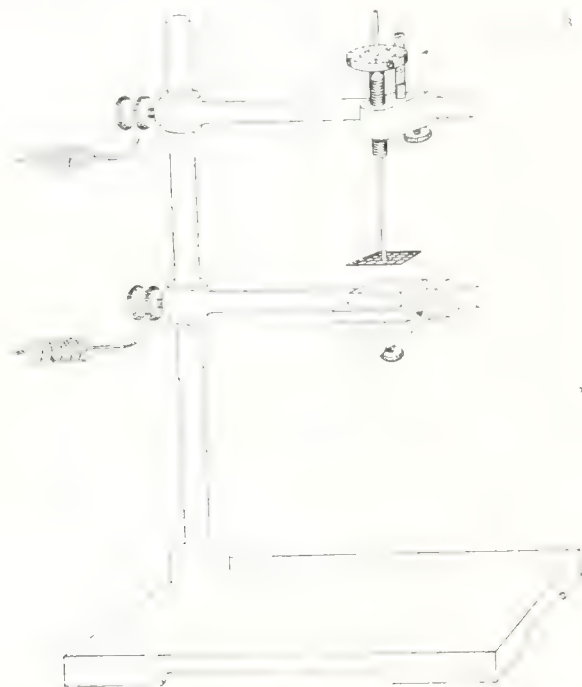


Fig. 1—Improved Type of Classen Stand

satisfactory way the power of resistance to corrosion in actual practice. For example, the relative order of resistance of different specimens of steel when exposed to atmos-

made in regard to the non-ferrous metals and alloys.

Another form of test consists in determining the electromotive force which is developed when the specimen of metal under examination is connected with a standard metal and is immersed in a suitable electrolyte. It has been assumed that an arrangement of different metals in an electro-chemical series in this way will indicate the relative order of resistance to corrosion, all corrosion being regarded as electrolytic in character. This test has proved valueless in practice. The effects of polarization are so complex that it is almost impossible to obtain comparable results with different specimens, the values of the electromotive force vary greatly with time, and even the values obtained when some kind of equilibrium appears to have been reached, bear little or no relation to the properties observed in practice.

Defects of Ordinary Corrosion Tests

The principal defect of laboratory tests

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of corrosion, and especially of accelerated tests, is their neglect to take into account the mechanical factors which influence the process. A specimen of metal is immersed in a solution or is exposed to the atmosphere. After a sufficient length of time the specimen is withdrawn, washed, and then brushed or scraped until an apparently clean surface of metal is again exposed. The loss of weight is then regarded as representing the amount of corrosion. This determination is sometimes supplemented by an analysis of the "corrosion product" under which are included the salts dissolved by the liquid, the flocculent precipitate of basic salts which is formed when the electrolyte is neutral, and any adherent crust, either of oxide or of metal. Moreover, when the alloy is made up of two different kinds of crystals, exfoliation is sometimes observed, and the crystals which are thus dislodged also find their way into the "corrosion product." An analysis of such a heterogeneous mixture throws little light on the process of corrosion.

Observation of corrosion under industrial conditions makes it evident that the mechanical properties of the substances formed during the process exercise an important influence on its velocity. For example, iron corrodes much more rapidly in ordinary moist air than either zinc or aluminum, a fact which would not be inferred from the relative positions of the three metals in the electro-chemical series, or from their behavior when immersed in dilute acids. The difference is due to the fact that iron forms a porous rust, which admits the passage of gases and of condensed moisture, thus facilitating further corrosion, while both zinc and aluminum form a tough, adherent layer of basic salts, which serves as a protective varnish and, even when quite thin, hinders any further action of the corrosive substances. This factor, which is left out of consideration in ordinary accelerated tests, and even in prolonged tests in which only the loss of weight is determined, is of the highest importance.

Retardation of Corrosion by Tin

The influence of tin on the corrosion of brass may be taken as an illustration. It has long been known from practical experience, that the resistance of brass to corrosion by sea water is greatly increased

by the presence of a small quantity of tin in the alloy, and the standard Admiralty alloy for condenser tubes consists of copper, 70 per cent; zinc, 29 per cent, and tin, 1 per cent. The effect of tin cannot be accounted for on electro-chemical grounds, as the effect on the solution pressure of the zinc must be very small. Experiments by the method to be described, however, prove that the influence of tin is largely, perhaps entirely, mechanical. Corrosion begins in the usual way, at a rate differing little from that of a similar alloy containing no tin. In the presence of a neutral electrolyte, a part of the dissolved metals is precipitated in the form of a basic salt. Copper and zinc are converted into loose, flocculent precipitates which are readily detached from the surface of the metal by even the lightest washings of water. The tin, on the other hand, although present in such small quantity, forms a tough adherent layer which, even when very thin, has the properties of an impervious varnish, and can only be detached from the surface with difficulty. Lead, which also exerts a protective influence on brass, acts in a similar manner, but it is found that a larger proportion of lead is necessary in order to produce a favorable effect, a small addition being insufficient to render the layer of basic salt compact. Iron, on the other hand, is quite without protective influence on brass, and indeed accelerates the process of corrosion.

The elaborate experiments with full-sized condenser tubes, conducted by Dr. Bengough for the Corrosion Committee of the Institute of Metals, have shown the importance of solid deposits in affecting the nature and extent of the corrosion of brass by sea water. The influence of solid particles of coke or other foreign matter in contact with the metals is still under discussion, but appears to be considerable.

Scientific Methods of Investigation

In order to test metals in regard to their power of resisting corrosion, a method was devised that is rapid, applicable to small specimens, and suitable for the investigation of the influence of the adherent films, we have just considered. In the case of alloys composed of two or more micrographic constituents, it was also thought desirable to observe the relative rate of corrosion of these constituents. For this purpose it was

decided to use specimens of the size usually adopted for metallographic examination, having a polished surface suitable for direct observation by means of the microscope. The rate of corrosion was also assisted and regulated by the application of an external electromotive force. Objections have been urged against such a procedure, on the ground that chemical and electrolytic corrosion are different in character, but experiments with condenser tubes have clearly shown that the mechanism of the two processes is identical, while the conditions of a rapid laboratory test cannot be fulfilled without the aid of such a force. The method adopted by Mr. S. Whyte consisted in supporting a small platinum cathode one centimeter (0.39370 in.) above the horizontal polished surface of the specimen by means of a Classen stand for electrolytic analysis. A containing cell was built up of plasticene (a non-drying modeling clay) and the electrolyte was then introduced by means of a pipette. The external electromotive force was supplied by two dry cells.

In working with the Classen stand an improvement suggested itself, and a special apparatus was devised consisting of a stand carrying a vertical brass rod which was divided into two parts and connected together again by an ebonite sleeve for purposes of insulation. The lower section of the rod carries an arm which may be adjusted to any position vertically on the rod. The arm terminates in a small brass block provided with spring clips for holding the specimen. The latter is 12.5 millimeters square, and is held with the polished surface upward. The upper part of the rod carries another arm also adjustable. This arm suspends a piece of fine platinum gauze 10 millimeters square, over the specimen held by the lower arm. The gauze has a piece of brass wire attached vertically to its center, and the free end of the wire is held in a hole in the upper arm by means of a milled screw. Arrangements are made to permit delicate adjustment of the height of the gauze above the brass block on the lower arm, and for conducting the electric current to the two arms.

The specimen to be tested is prepared as if for microscopical examination, is carefully freed from all grease and placed in position on the lower arm. The cathode is then lowered until in contact with the

specimen and is then raised 5 millimeters. A wall is then built up around the specimen to contain the electrolyte. This wall is of plasticene and the electrolyte is usually 1 or 2 cu. centimeters of a 5 per cent solution of sodium chloride. The source of current is most conveniently a storage battery provided with a distributing board and measuring instruments for electrolytic analysis. Corrosion is then allowed to proceed for from 10 to 60 min. according to circumstances. The wires are disconnected, and the electrolyte is rinsed out of the plasticene cell into a beaker using a wash bottle with a fine jet. A loose flocculent precipitate is usually obtained. Any solid deposit adhering to the corroded surface so loosely that it may be detached by light

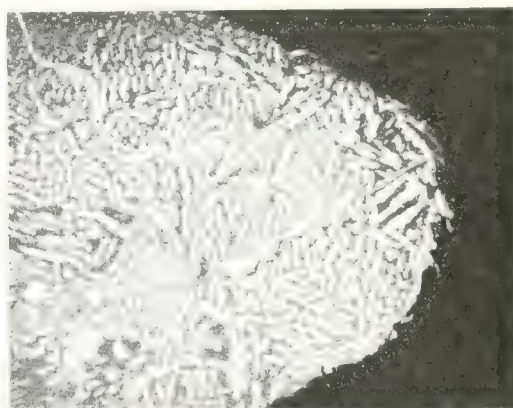


Fig. 3—Ship's Bolt Magnified 50 Diameters

rubbing with the finger tip, may usually be added to the bulk, but a firmly adherent deposit, requiring the use of a wooden chisel edge or a knife blade to detach it, should be collected, if present, for separate analysis.

The surface of the corroded metal is examined under the microscope both before and after the removal of the adherent layer. The texture of the latter is thus observed, as well as the nature of the attack on the metal, and the comparative behavior of different micrographic constituents, when such are present in an alloy. The analysis of the products of corrosion is performed as far as possible by colorimetric methods, on account of the very small quantity of each element to be estimated, amounting in many cases to only a fraction of a milligram. It has been found possible to estimate the proportions of copper, zinc, iron, tin, and lead with a satisfactory degree of accuracy, and there will probably be no difficulty in estimating other metals in a similar manner.

Results of Experimental Work

Experiments on the corrosion of brasses of differing composition have led to the following conclusions:

Corrosion of brasses takes place by dezincification. Both copper and zinc are removed in solution, but the ratio of zinc to copper in the solution and the flocculent precipitate is much higher than in the alloy.

The beta alloys are much more readily attacked than the alpha alloys and the preferential removal of zinc is much more strongly marked in alloys of the former class.

In alloys containing both alpha and beta constituents, the latter is almost completely corroded before the former is attacked. A layer of metal is left below the corroded surface, containing much less zinc than the original alloy, and having an open, spongy texture. In the case of the beta alloys, this layer may contain as much as 99.6 per cent of copper. It is sharply defined in depth, that is to say a gradual transition from unaltered to completely dezincified brass is not observable. This is true of alpha as well as of beta alloys.

The spongy layer readily oxidizes under the influence of atmospheric or dissolved oxygen. The layer of cuprous oxide, which is often observed on the corroded surface of brass tubes, is doubtless of secondary origin, the original process having been one of dezincification.

The removal of zinc proceeds at first along the boundaries of crystal grains, and in the case of alpha brasses, which commonly exhibit twinning, along the dividing planes between twin crystals. Well defined etch figures are frequently seen on the surface of both kinds of brasses after removal of the coppery layer. The presence of iron in solid solution accelerates corrosion, while that of tin checks it after the process has continued for a very short time. This check is not due to electro-chemical causes, but to the mechanical protection afforded by a tough, adherent layer of basic salts, containing tin. Lead in small quantities is without protective effect, but with 2 per cent of lead (in the case of alpha brass) a protective layer of basic salts is formed, and corrosion is greatly retarded in spite of the fact that distinct dezincification is observed at first around the globules of lead in the alloy.

The process of corrosion by sea and other

natural waters is of essentially the same character as that of electrolytically stimulated corrosion under the conditions described above. This conclusion has been confirmed by the comparison of laboratory specimens with portions cut from tubes and plates which have become corroded during actual use. For example, a condenser tube which had undergone extensive corrosion by Manchester Ship Canal water was examined. The original brass had contained copper, 72.72 per cent; zinc, 27.04 per cent; iron, 0.15 per cent; lead, 0.09 per cent. Along the bottom of the tube a band of metal had been almost completely dezincified, while at a somewhat higher level the layer of spongy copper extended only partly through the thickness. Microscopical examination showed that the boundary be-



tween copper and brass was everywhere perfectly sharp, without any intermediate layer of partly dezincified alloy. Moreover, the removal of zinc was found to have proceeded by way of crystal boundaries and twinning planes before penetrating into the interior of the crystal grains. The same effects can be reproduced in their smallest details by means of electrically stimulated corrosion in the laboratory. A sound uncorroded section of the same condenser tube was converted into a cell by closing the lower end with plasticene. The tube, filled with sodium chloride solution, was connected so as to become the anode, a coiled platinum wire placed centrally, serving as cathode. After the current had passed for 24 hr. the section of tube was dried, sawn through and examined microscopically. The same features were observed, a completely dezincified layer, in which the brass was now represented by spongy copper, separated sharply from unaltered

brass, the dividing lines running along boundaries of crystal grains and twin lamellæ. Similar results have been obtained with other corroded objects.

When making an examination of a corroded tube it is necessary to fill the tube with fusible metal before cutting and grinding, in order to preserve the sharpness of the edges, and to prevent the disintegration of fragments of brittle copper.

Editorial Comment

The investigations of Dr. Desch as embodied in the foregoing report show the futility of attempting to determine the relative corrodibility of metals and alloys by the time honored method of immersion in the corrosive agent and weighing at intervals to discover the loss or gain of the tested specimen. This method is the one usually adopted to determine the fitness, or otherwise, of alloys for service under conditions where they will be exposed to the corrosive influence of tanning liquors, acid mine waters, alkali waters and other corrosive agents, and is often responsible for some very misleading results. The method advocated by Dr. Desch is quite simple and worthy of the careful consideration of all who are called upon to carry out investigations of this kind. The illustration, Fig. 1, shows the improved type of Classen stand described by Samuel Whyte, B.Sc., in a paper recently read before the British Institute of Metals, entitled "The Micro-Chemistry of Corrosion," which is a continuation of similar investigations previously carried out and described by the author and Dr. Desch. Mr. Whyte's description of the stand follows: "The base of the specimen, which was ground approximately parallel with the surface, rested on the platform A, Fig. 1, which had a universal movement and could be clamped in any position. The distance between the surface of the specimen and the platinum cathode was obtained accurately to within the hundredth of a millimeter by means of a screw with a graduated head, B, Fig. 1, into which the platinum wire of the cathode was fastened. The electromotive force was obtained from an accumulator and was kept constant by means of a sliding resistance and voltmeter. Two cubic centimeters of sodium chloride solution were used for each of the short period tests, and 100 cubic

centimeters for each of the long period tests."

The corrosion tests made by Mr. Whyte were carried out on alloys of the "Muntz Metal" class, that is brasses containing 60 per cent of copper and 40 per cent of tin approximately, with small additions of iron, lead and tin. The results showed that the corrosion of such alloys is largely a process of dezincification due to electrochemical differences between the constituents of the alloy. Both alpha and beta constituents are found in these alloys. The beta constituent is attacked first and becomes pitted, then is protected by a smooth, bright copper layer after which the corrosion extends to the alpha constituent. Micro-photographs of the various stages of this type of corrosion, shown in the paper, Figs. 2 and 3, illustrates how corrosion proceeds in a ship's bolt. Both illustrations are taken from cross-sections of one of the threads. Fig. 2 is heat tinted and Fig. 3 etched with dilute hydrochloric acid and ferric chloride, to show the original structure of the alloy and its relation to the process of corrosion. Fig. 4 shows a cross-section of a thin sheet of Muntz Metal, and the sharp junction between the copper and uncorroded brass can be easily noted. The zinc has been removed from the alloy and the copper left behind; in which process, electrolysis appears to have played a most important part. C. V.

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"Good men are not cheap, but the product of their labor is well worth the extra money. The manufacturers of the United States and Canada should encourage their foremen platers to become members of the American Electro-Platers' Society. Membership in this society adds dignity to the profession, dignity inspires respect, respect demands consideration and reduces the number of "chambers of horror," (dirty plating rooms) and consideration is reward for services, nothing is lost, and the more enthusiastic the member becomes the greater his reward in divers ways."—W. S. BARROWS, President American Electro-Platers' Society.

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There is no such thing as luck having a predominating effect on the successful making of castings in the foundry; but there are results and their causes, and there are correct ways and means.

Electrodeposition of Smooth Solid Lead From Lead Nitrate Solutions

By F. C. MATHERS and ASA McKINNEY*

Summary.—The electrolysis of solutions of lead nitrate produces a mass of loose crystals upon the cathode. Certain experimenters¹ have claimed to have improved the deposit by the use of addition agents, though in at least one of these cases Betts² has been unable to repeat the results.

The authors have succeeded in obtaining as smooth coherent lead deposits from lead nitrate solutions as from any other lead bath.

The best composition of the bath is: 10 per cent lead nitrate, 2.5 to 5 per cent acetic acid, and 1 per cent of the residue from the commercial extraction of Curaçao aloes in the manufacture of aloin. Crude aloes may be used in the place of the aloes residue but the deposits are not as good. The aloes or the residue should be dissolved by warming in the acetic acid before adding the lead nitrate solution. The bath should not be filtered before using. A current density of 0.4 amp. per sq. dec. (3.7 amp. per sq. ft.) may be used.

Free acetic acid is necessary in the bath to avoid the formation of basic salts. Free nitric acid in place of the free acetic acid greatly hastens the deterioration of the baths, and the greater the concentration of the acid the quicker the deterioration of the baths.

A number of addition agents were tried, but none approached the residue from Curaçao aloes in efficacy. The aqueous extract of poplar wood, which gave excellent deposits in acetate baths, was not satisfactory in these nitrate solutions.

The baths have a life of only six or seven weeks, after which the deposits become spongy and non-adherent; consequently it seems unlikely that this nitrate bath can have any practical use. No way was found to overcome this deterioration of the baths.

A rough but not spongy deposit shows the exhaustion of some constituent of the bath. Warming the bath for a few minutes will bring more of the aloes residue into solution and correct any trouble due to lack of addition agent. Sometimes more acetic acid must be added to replace that which has been used in chemically dissolving the lead.

Manipulation.—A cathode of thinly rolled lead was suspended between two lead anodes in a bath containing 200 c.c. of the solution. The current density was 0.4 amp. per sq. dec. (3.7 amp. per sq. ft.). Electrolysis was at room temperature. The cathodes were 5 by 5 cm. (1.9 by 1.9 in.) and the anodes 3.5 by 4 cm. (1.4 by 1.6 in.). The cathodes were cleaned by dipping in nitric acid before placing them in the baths. A cleaner, brighter surface was obtained in cleaning those cathodes which were made from lead containing some mercury. The lead anodes were either amalgamated or wrapped in filter paper to prevent slime reaching the cathodes and producing rough places. The anodes were suspended by copper wires which did not dissolve during the electrolysis.

Effect of Various Addition Agents.—Of the addition agents which were tried, the residue of gum which remained after the extraction of Curaçao aloes in the commercial manufacture of aloin was vastly superior to any other. A sample³ of this residue was furnished to us by Sharp & Dome, manufacturing chemists, Baltimore, Md. This is the addition agent that gave such excellent results in the deposition of lead from lead acetate⁴, lead lactate⁵ and lead formate⁵ solutions.

The baths used in testing the effect of addition agents contained 10 per cent lead nitrate, 4 per cent sodium nitrate, 5 per

*Paper read at General Meeting American Electrochemical Society, Atlantic City, April, 1915.

¹Jarvis and Kern, *Trans. Amer. Electrochem. Soc.*, 15, 453 (1909); Tucker and Thomssen, *Ibid.*, 15, 477; Matuschek, Austrian Pat. 5766 (1909) and D. R. P. 239,222 (1910); Glaser, *Zeit. Electrochem.*, 7, 365 and 381 (1900-01).

²*Trans. Amer. Electrochem. Soc.*, 6, 35 (1904).

A few experiments were tried with a sample of residue which was obtained from the Norwich Pharmacy Co., through the assistance of the New York Quinine & Chemical Co., both of New York. This residue contained more water-soluble material and gave rougher deposits than the sample from Sharp & Dome.

⁴Mathers, *Trans. Amer. Electrochem. Soc.*, 26, 99 (1914).

⁵Mathers and Cockrum, *Ibid.*, 26, 117 (1914).

cent acetic acid and 0.5 per cent of the addition agent except in the case of liquid addition agents, where 4 drops were added to each 200 c.c. bath. The solid addition agents were dissolved as completely as possible by warming in the acetic acid and the solution thus obtained was added to the bath. The following substances, besides the aloes, were tried as addition agents: Galbanum, sandarac, saponin, benzoin, guaiac, euphorbia, myrrh, garcinia hamburii, eucalyptus rostrata, pterocarpus marsupium,

which they became non-adherent and finally spongy.

Deterioration of the Baths.—Baths acidified with nitric acid rapidly reached a stage after which only spongy deposits could be obtained. Even with the addition of aloes residue a fair deposit could be produced only for a few days. Substitution of acetic acid for free nitric acid greatly lengthened the life of the baths.

Deterioration took place in the case of the best baths after seven weeks' continu-

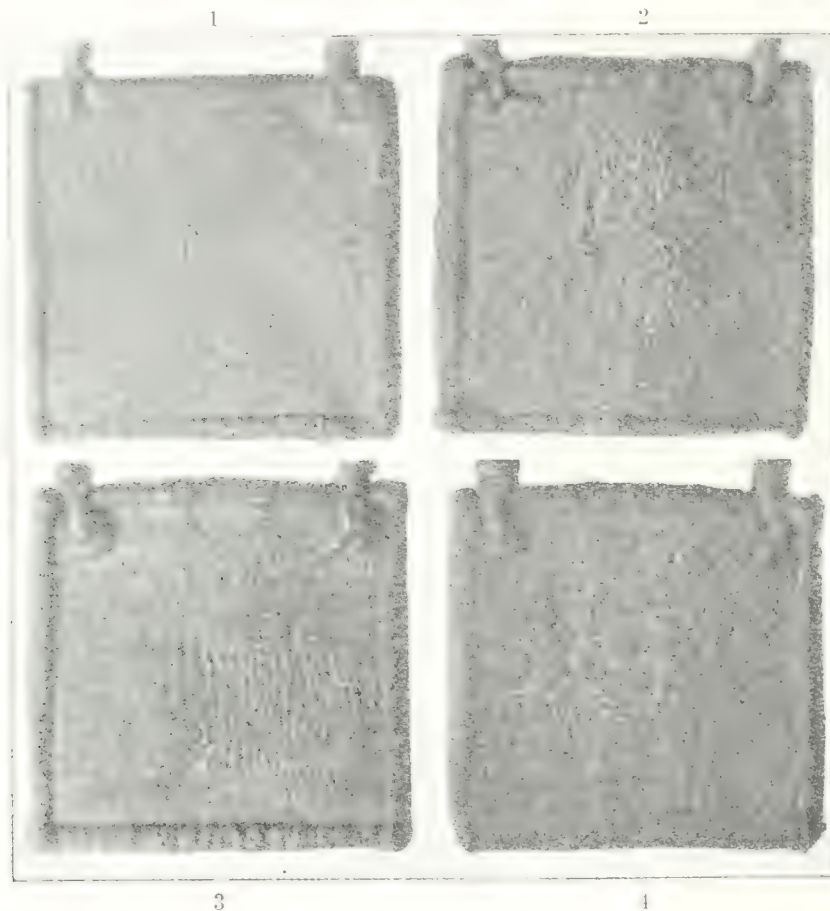


Fig.1

The baths from which these lead cathodes were obtained were as follows:

1. Lead nitrate, 5 per cent; sodium nitrate, 2 per cent; acetic acid, 2.5 per cent; Curaçao aloes residue, 1 per cent.
2. Lead nitrate, 20 per cent; sodium nitrate, 2 per cent; acetic acid, 2.5 per cent; Curaçao

tragacanth, balsam tolu, manna, gambir, gamboge, convolvulus scammonia, asafetida, mastic, lycopodium, terpine, caramel, casein, catechu, ammoniac, terpin hydrate, menthol, tannigen, phloridzin, salicin, gum arabic, formaldehyde, mace, glue, agar-agar, nitroso β -naphthol, licorice extract, and the essential oils of clove, cedar, eucalyptus, juniper, sandalwood, and sassafras. In almost all cases the deposits were crystalline or spongy and non-adherent or rough. The deposits with the licorice and the phloridzin were smooth for about two days, after

- aloes residue, 1 per cent.
3. Lead nitrate, 10 per cent; sodium nitrate, 0 per cent; acetic acid, 2.5 per cent; Curaçao aloes residue, 1 per cent.
4. Lead nitrate, 10 per cent; sodium nitrate, 16 per cent; acetic acid, 2.5 per cent; Curaçao aloes residue, 1 per cent.

ous electrolysis. The further addition of aloes residue, of acetic acid, also of formaldehyde (0.5 to 2.5 per cent by volume of the 40 per cent solution), hydrogen peroxide (0.5 to 15 per cent by volume of the 3 per cent solution) and ammonium nitrate (2 per cent) produced no important improvement in the deteriorated baths, though slight improvement was obtained with the hydrogen peroxide. Some of these additions were tried because it was suspected that nitrous acid, which was found in appreciable quantities in deteriorated baths, though also in

traces in baths in good working order, might be the cause of the deterioration. New baths deteriorated in forty-eight hours after the addition of 0.15 per cent of sodium nitrite; this deterioration was not prevented by the addition of formaldehyde, urea, or ammonium nitrate, but was prevented by the addition of 5 to 10 per cent by volume of 3 per cent hydrogen peroxide. Hydrogen peroxide added to new baths lengthened their life only slightly.

Composition of Baths.—The effect of variation of individual constituents was tried on a bath containing, except as stated, lead nitrate 10 per cent, sodium nitrate 4 per cent, acetic acid 2.5 per cent, Curaçao aloes residue 0.5 per cent.

Variation of lead nitrate: 3 per cent rough and slightly spongy; 5, 10, 20, and 25 per cent excellent but with life (as regards time until deterioration) decreasing and degree of smoothness increasing with increase of concentration. The 10 per cent lead nitrate bath seemed most generally suitable, giving deposits sufficiently smoother than the 5 per cent bath to compensate for its slightly shorter life.

Variation of sodium nitrate: No improvement from 0 to 16 per cent; shorter life with the larger amounts; this constituent should therefore be omitted.

Variation of acetic acid: Without acid the deposit was black and spongy; with 2.5 to 5 per cent good, the latter being somewhat the better; with increasing percentages up to 50 the deposit became slightly rougher and the life shorter.

Variation of Curaçao aloes residue: No variation in initial results with baths containing 0.05 to 1.5 per cent. Roughness of deposit sets in in order of dilution, the bath containing the largest amount of aloes giving the best deposit for the longest time. One per cent should be used, since with larger quantities the insoluble matter in the bath is sufficient to make the cathodes rough. Baths which are giving rough deposits owing to exhaustion of the aloes residue in solution may be improved by heating to boiling, which brings more of the aloes residue into solution.

Current Density and Voltage.—A higher current than 0.4 amp. per sq. dec. (3.7 amp. per sq. ft.) should not be used. A current of one ampere produced rough deposits and hastened the deterioration of the baths. A bath that would have produced good de-

posits for five or six weeks at 0.4 amp. deteriorated and gave spongy deposits in six or eight days when electrolyzed at 1 amp. per sq. dec.

With a bath containing 5 per cent acetic acid, 5 per cent lead nitrate and 0.5 per cent Curaçao aloes residue, the voltage averaged 0.35 with a current of 0.4 amp. and the anode and cathode about 2 cm. (0.79 in.) apart.

Current Efficiency.—In a series of measurements which were made daily for a period of ten days on a bath containing 5 per cent lead nitrate, 5 per cent acetic acid and 0.5 per cent Curaçao aloes residue, the observed variations from theoretical cathode efficiency lay within the limits of experimental error, averaging 99.98 per cent, while the anode efficiency, as is the case in all lead baths⁶, was appreciably over the theoretical value, averaging 100.6 per cent. The anodes, made of once electrodeposited lead, were amalgamated on the surface, hence the high anode efficiency is not due to mechanical loss.

Properties of the Cathodes.—The specific gravity of the cathode which was deposited from the bath containing 10 per cent lead nitrate, 10 per cent acetic acid, 1 per cent Curaçao aloes residue and 4 per cent sodium nitrate, was determined with a pycnometer at 20 deg. C. A section of the cathode containing the starting sheet gave the value 11.32, while material from which this starting sheet had been sawed away gave values of 11.32 and 11.33. This latter material after melting and casting showed a specific gravity of 11.36. These results show that lead electrodeposited from the nitrate solution is very dense.

The cathodes are brittle and hard. These properties are probably caused by the comparatively large quantities of addition agent that is absorbed, while in the cases of the fluosilicate and perchlorate baths, where only small quantities of the glue and clove oil are used, the cathodes are tough and soft. No attempt was made to determine the quantity of addition agent in the cathodes.

An attempt to determine the nitrate in the cathode lead, caused by inclusion of the electrolyte in the deposit, was made by a method which has been used⁷ in testing sil-

⁶Mathers, Trans. Amer. Electrochem. Soc., 17, 266 (1910).

⁷Rosa, Vinal and McDaniel, Elect. World, 63, 374 (1914); Bur. Standards Bull., 10, 520 (1914).

ver deposited in a silver coulometer. Four grams of the lead cathode, in the form of fine cuttings obtained with a hack-saw, was treated with 6 to 8 gms. of mercury and two drops of sulphuric acid. This mixture was warmed for a few minutes and filtered. The filtrate was tested for nitrate by the phenol-sulphonic acid method used in water analysis. The color was browner than the standard hence only an approximate comparison was possible. The average of several determinations showed 0.0024 per cent of lead nitrate. The mercury may not have released all of the nitrate (further treatment of the amalgam gave no appreciable quantities of nitrate), nevertheless the result indicates that only small amounts of the electrolyte are included in the lead deposit.

Remarks.—This work was taken up for the purpose of obtaining more information upon the question of the use of addition agents in metal deposition. Until recently it was supposed that solid lead deposits could be obtained only from baths containing lead salts of perchloric acid or of a fluorine acid such as fluosilicic, fluoboric, etc., with the proper addition agent in each case. The good behavior of these baths was supposed to depend upon the fact that the acids in them were strongly dissociating and non-oxidizing. This last property was added to exclude nitrate baths because it was known that lead nitrate solutions gave crystalline, non-adherent deposits although nitric acid is a very strongly dissociating acid. Solutions of lead acetate or lactate or formate were supposed to be unsuited for the deposition of lead because these organic acids were very weakly dissociated. However in previous papers^{1,2} it has been shown that solid deposits of lead can be obtained from solutions of the lead salts of these weak acids. It was desirable to find out the conditions for obtaining good deposits from lead nitrate solution in order to make plain the fact that solid deposits of lead may be obtained from the lead salts of any acid whatever, regardless of whether it is weak or strong, oxidizing or non-oxidizing, organic or inorganic. The important thing is to use the proper addition agent for the particular salt in question. This theory, which was advanced in an earlier paper³,

now seems proved, since a lead salt of each kind or class of acids has been made to yield a good deposit.

Blue is used as addition agent in the fluosilicate or fluoborate baths, but it gives only fair deposits in the perchlorate bath and is entirely unsatisfactory in the acetate and nitrate baths. Clove oil is the best addition agent in the perchlorate bath and seems to be as good as the blue in the fluosilicate, but is worthless in the acetate of the nitrate baths. Extracts of poplar wood, obtained by boiling the wood in water, is of little value in the nitrate solutions, but it is the best addition agent in the nitrate or acetate solutions. These facts point to the great effect which the negative or acid radicle has upon the deposits, otherwise an addition agent that gave a good deposit in one lead bath would give an equally good deposit in all other lead solutions.

No work was done to try to determine why these particular addition agents produced the good deposits.

Production of Pyrite and Sulphuric Acid in 1914

The production of pyrite in the United States in 1914, according to the U. S. Geological Survey, was 336,662 long tons, valued at \$1,283,346. There was a decrease in 1914 of slightly more than 1 per cent, and of \$2,738 in value, or but one-fifth of 1 per cent. Virginia is the leading State in both production and value. The imports of pyrite for consumption during the calendar year 1914 were 1,026,617 long tons, valued at \$4,797,326. These figures show a notable increase compared with the imports of 1913.

According to actual returns for the year 1914 the production of sulphuric acid in the United States was 3,762,417 short tons of 50 deg. acid, valued at \$24,163,331. This is exclusive of 21,993 short tons of fuming acid, valued at \$316,596, but the figures given above include by-product acid—that is, acid obtained in the smelter industry. The acid produced at copper and zinc smelters in 1914 amounted to 950,798 short tons of 50 deg. acid, valued at \$5,190,293.

Fred W. Gleim, Hot Springs, Va., is in line with others, when he writes: "I received your magazine which I think is fine. I would not be without it."

¹ Richards and Anderegg, Jour. Amer. Chem. Soc., 37, 10 (1915).

² Mathers, Trans. Amer. Electrochem. Soc., 24, 315 (1913).

The Cast and Drawn Brass Parts of Shrapnel

By EFFICIENCY

The large orders for shrapnel shells placed in Canada and the United States by the warring European Powers have been a great stimulus to the brass business on this side of the Atlantic. The development of these shells represents a vast amount of experiment and study, but the shell itself is not comparable with the wonderful processes and tools employed in its manufacture. The most interesting phases of

blanks, and are cast in iron molds or chills open on top like ingots, and as fast as the metal solidifies the molds are emptied and refilled, the process thus being continuous. The castings require no cleaning, the only operation performed being a rough sizing cut which is taken off the face in a continuous milling machine. The method of pouring these blanks is illustrated in Fig. 2.

To obtain the form desired, the blanks are put through a forging operation. For this purpose a 250-ton stamping press is employed, the dies being very simple. The blanks are brought to a red heat in an oil

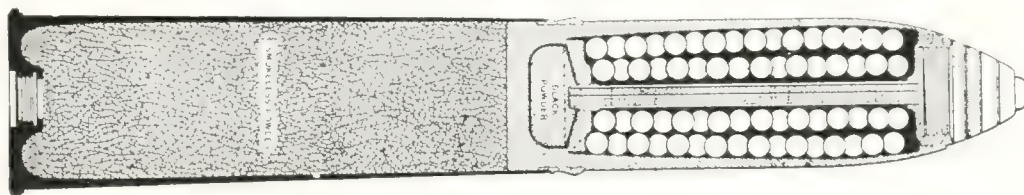


Fig. 1

shrapnel manufacture are the formation of the brass case, the forging of the steel shell, and the finishing of the various shell and fuse parts to the degree of accuracy required.

The production of the brass case of a British 18-pounder shell requires 17 different operations. The case is 11½ inches long and 3¾ inches in diameter, and is formed from a flat circular blank 6½ inches in diameter and ⅜ of an inch thick. This blank is first drawn into a shallow cup, and is then gradually elongated by being forced through steel dies progressively smaller in diameter. These drawing operations are so controlled that only the sides of the case are made thinner, the bottom retaining the original thickness to insure the required strength. The case when drawn must be smooth and seamless, and the next operation is to turn the bottom true, and to bore and thread a central hole to receive the primer or cap for exploding the propelling charge. As these brass cases as well as those for other kinds of ammunition contain about 65 per cent of copper, the importance of this metal in modern warfare is apparent. The illustration, Fig. 1, shows a complete British 18-pounder shell.

For the nose of the shrapnel shell, brass plugs and socket castings are required. These are simple circular shapes easily made in the foundry, of a special forgeable alloy. They are merely plain round

furnace. Three men are employed. One looks after the heating, a second places the blanks in the die, and a third operates the press and removes the finished forging. The punch is stripped from the forging by the use of oil applied by a swab before each



Fig. 2

stamping. The stripping from the die is accomplished by two rods extending down through the die plate by the upper bolster. The operation is very rapid, and either sockets or plugs can be formed practically as fast as they can be handled.

The various parts are now ready for the finishing operations, which are carried out in the usual manner on brass monitor lathes. The finished parts are then inspected by Government officials, after which they are ready for shipment to the various concerns who specialize on the steel part of the shells.

The density of the metal after undergoing the forging process makes the tensile strength very high. The brass plug is merely used to protect the thread in the socket, and also to keep moisture and foreign substances from entering the tube until the shell is ready for use, when the plug is removed and the time fuse is inserted in its place.

◆ Diseased Metal

By ROBERT I. CLEGG

A curious condition in metal is what might be termed "disease."

Faults may occur in the composition of an alloy, but these are not what is meant by the above word "disease." Such mistakes are no more or less than the accidental lapses of judgment that will somehow creep into the best of plants no matter how well managed they may be.

Whenever these errors in mixtures happen there is usually no great mystery about their causes, provided some little study is given to the facts. Given the evidence as to plain physical conditions, and these particulars be properly backed up by tests, and the conclusions are about as inevitable as taxes, maybe more so.

But there are some troublesome peculiarities about the metals that do not fall into such easy categories. They are less evident in their aspects.

Exactly what it is that causes a perfectly sound appearing piece of metal to change its structural strength when not under apparent pressure or action of either mechanical or physical or chemical character is a problem. But from time to time further light is being thrown upon these faulty conditions and it is seen unquestionably that not in all cases has the responsibility been rightly placed.

For instance, as has been shown in the BRASS WORLD, the effect of working the material has much to do with the breaking down of the structure that comes about in drawn stock. Very probably many of

these troubles with drawn work are due to the stock being in part "formed" only.

If the work is reshaped by pressure between opposing surfaces, such as in drawing tubing on rods through die plates, or swaging up sheet or other stock in dies, then if the alteration of shape is not so complete that the substance everywhere flows to new places, the stock rolls or shells over itself into layers forming a sort of strata like paper folded in sheets.

It will be noted that where in such examples the metal may be in the first place correctly prepared, skilfully mixed, and then properly melted and cast, yet after working there can be found serious segregation deficiencies in the material, the metal no longer having the intimate cohesion that reasonably might be expected and that was doubtless accurately planned and carried out in all the preliminary stages of the work.

A happy medium between sufficient pressure to cause the metal to flow uniformly and not to stratify, and a pressure not so great that it will cause complete rupture of the stock, is most desirable.

Leaving these mechanical complications, we are not yet entirely free of danger elsewhere. There is here a fascinating branch of investigation that, if we may venture upon borrowing a descriptive term from the medical fraternity, might be fairly said to be "pathological." Here we are in the consideration of the abnormal condition of bodies, when sound health gives place to disease as when good healthy metal becomes attacked by illness of more or less progressive nature and seriousness.

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Regularly monthly sales of tin have been held in Amsterdam for many years, the turnover being ordinarily very large. Last year was an unfavorable one for the Dutch tin trade, prices for Banca fluctuating from the beginning. The supply of Banca on hand at the end of December was 116,581 slabs, and there were no arrivals from the Dutch East Indies in the last few months of the year, the Government storing the tin at Batavia.

As to the visible supply in 1914, trade statistics show the largest amount in May—20,039 tons—the smallest in October—13,128 tons. The year closed with 15,656 tons on hand, almost the same quantity as at the close of 1913.

CLEANING AND PLATING IN THE SAME SOLUTION

By OLIVER P. WATTS

Although the simultaneous cleaning and plating of metals in a single solution is now quite extensively practised, the literature upon this subject is extremely scanty, being limited, so far as the writer has observed, to a few patents and a brief published article by Mr. E. G. Lovering.

In spite of the slight attention paid to this process in the books and periodicals devoted to plating, it is well worth a trial by every plater. After a series of experiments in the University laboratories, the writer believes that the general adoption of the combined cleaning and plating solution will prove almost as revolutionary in plating-room practice as has the electric cleaner. Once adopted, the plater will wonder how he ever did his work without it.

Before considering baths for cleaning and plating in a single operation, it may be well to devote a few minutes to the electric cleaner.

It may be news to many here that electric cleaning of metals for plating by use of the dynamo current was discovered in Wisconsin at the State University, but that such is the case is shown by a report in the *Electrical World* for October 29, 1898, of experiments by C. F. Burgess. Adoption of the process by platers proceeded very slowly, and it is only in recent years that the great value of this method of removing grease from metal has been generally recognized.

The principle of operation is simple. When an electric current is passed through a solution of any sodium or potassium salt hydrogen is liberated and a film of alkali is produced on the cathode. There is therefore a two-fold cleaning effect; the alkali tends to saponify animal and vegetable fats, and the hydrogen which is set free under the grease upon the metallic surface knocks off particles of grease in its escape. The higher the current density, the more rapid and effective the cleaning, because of the more violent evolution of hydrogen, and

the greater concentration of the film of alkali produced by the current. If instead of using as electrolyte a neutral salt, such as sodium sulphate, or cyanide, which of itself has no action on grease, sodium carbonate or lye be substituted, the chemical action of these substances is added to the electrochemical cleaning already referred to, and the cleaning process is greatly accelerated. Lye also plays the part of a conducting salt, and greatly lessens the resistance of the solution. Heat is a great accelerator of electric cleaning. The tremendous effect of rise of temperature upon the velocity of chemical action is well known, and the saponification of fats by alkalies is no exception to the general rule. Besides increasing the rate of cleaning by accelerating the action of the alkali present in the solution, heating greatly lessens the resistance and therefore increases the current. This results in an enormous increase in the rate of cleaning by a hot, in comparison with a cold, electric cleaner. The use of cold electric cleaners is not to be encouraged, since 90 per cent. or more of the possible cleaning power is not utilized at low temperature.

That the regular cyanide copper solution possesses some cleaning power has been known for many years. The reason is easily seen. When in use hydrogen is always evolved at the cathode and a corresponding amount of lye is produced there. This dissolving action of cyanide baths on grease, under the influence of the current, combined with their solvent power for many metallic oxides was probably the reason for the addition of cyanide to many of the earlier electric cleaners. Now that it is recognized that cyanide does not help the electric cleaner in removing grease from metals, its use has been generally discontinued.

To secure the greatest cleaning power from the electric cleaner requires a boiling solution strong in lye and, by the use of large electric conductors, the delivery of the

full voltage of the dynamo at the cleaning tank. For cleaning metals which are attacked by lye, or where the maximum of cleaning power is not needed, soda ash or sal soda may be substituted for lye, and the bath may be operated below the boiling point.

In order that a plating bath may remove grease one of two things is necessary—there must be a vigorous evolution of gas on the work during plating, or the solution must be used hot and must contain enough lye or other saponifier of grease to clean by chemical action. Most effective cleaning requires a vigorous evolution of gas in a hot, strongly alkaline plating bath.

Many of the plating baths now in use evolve hydrogen vigorously only when strongly acid, or so weak in metal as to produce a burnt deposit. Many metals are precipitated by alkalis, so that a strongly alkaline solution of them cannot be made. It is therefore evident that cleaning and plating in a single solution will be somewhat limited in its application.

Lovering's formula, previously referred to, for cleaning and depositing brass, is as follows:

Lye	8 oz.
Copper carbonate	2 oz.
Zinc carbonate	2 oz.
Ammonium carbonate	4 oz.
Potassium cyanide	4 oz.
Water	1 gallon

For a copper solution he recommends the same without the zinc carbonate. Both solutions are used at the boiling point and are claimed to work with great rapidity.

Starting with Lovering's solution as a basis, many experiments have been tried in the University laboratories. It was soon found that the bath needed more cyanide than given in the formula, but even with a great increase of cyanide anode corrosion was not satisfactory. The presence of lye caused a coating of copper oxide to form on the anodes. It was discovered that the addition of Rochelle salt dissolved this film and caused excellent anode corrosion, even at extremely high current densities.

The following is recommended as a good solution for cleaning and depositing copper:

<i>English</i>	<i>Metric</i>
8 oz. Lye	60 grams
1 oz. Copper carbonate	30 grams
8 oz. Sodium cyanide	60 grams
12 oz. Rochelle salt	90 grams
1 gal. Water	1000 c.c.

The addition of 4 oz. of ammonium carbonate will cause a brighter deposit from a

freshly made bath, but since ammonium salts are expelled by boiling lye, this addition is not recommended. Experiments with this and other solutions have already been described in a paper presented at the April meeting of the American Electrochemical Society, and therefore will not be repeated here. The solution should be used between 158 deg. F. (70 deg. C.) and the boiling point at current densities of 60 to 250 amperes per square foot.

The fraction of the total current devoted to cleaning may be controlled by regulating the amount of free cyanide. An increase of cyanide causes more vigorous cleaning, and increasing the current density has the same effect. Current efficiencies vary from 55 to 90 per cent., depending on the amount of free cyanide, the current density and the temperature. The less the current density and the higher the temperature, the greater will be the current efficiency. Lye is without effect on the current efficiency.

In comparing rapidity of deposition of copper from this and other solutions, it should be noted that a cyanide solution at 50 per cent. efficiency deposits as much metal as the sulphate solution at 100 per cent. This fact, together with the low resistance due to the lye, and the very high current density which may be used without causing a burnt deposit, all combine to yield a more rapid deposition of metal than from any other bath in use to-day.

If a maximum of cleaning and a minimum of plating is desired, this can be obtained by diminishing the amount of copper and Rochelle salt, and increasing the amount of cyanide and lye. When it is desired to have a low current efficiency at the cathode, the composition of the solution should be altered in such a way as to keep the rate of solution of metal from the anode equal to deposition at the cathode, and thus maintain the original composition of the bath—which, in this case, means to diminish the amount of Rochelle salt—the material, which in the presence of free cyanide, promotes anode corrosion.

Experiments with this solution in plating sheets of copper, brass, zinc and iron, just as they came from the polishing wheels, showed perfect adhesion of the deposit without the formation of a single blister. The remarkable power which this solution possesses of penetrating surface coatings of grease and rust, and depositing firmly

adherent copper upon the metal beneath, is strikingly illustrated by the illustration here presented.

This is the raw material for plating—a bar of heavily rusted steel picked from a scrap pile where it had been exposed to the weather all winter.

Has any plater a solution which he will guarantee to deposit a thick, firm, adherent coating of metal on this bar with no preliminary cleaning?

This bar, plated five minutes at 25 amperes, and scratch-brushed. The iron rust had been forced off of the part immersed in the bath.

A piece was cut with a hack saw after plating to test the adhesion of the deposit, which proved entirely satisfactory.

Brass

Experiments with Lovering's brass solution resulted in several changes in composition. One of the first solutions used had the following composition:

2 oz. zinc carbonate	15 grams
4 oz. copper carbonate	30 grams
8 oz. lye	60 grams
7 oz. ammonium carbonate	50 grams
10 oz. Rochelle salt	75 grams
17 oz. potassium cyanide	120 grams
1 gal. water	1000 c.c.

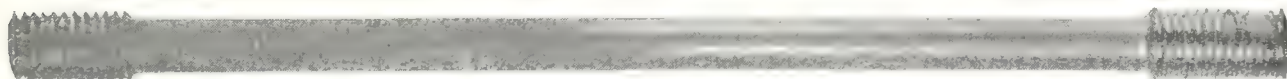
At 176 deg. F. (80 deg. C.) this solution deposited good yellow brass between current densities of 50 and 150 amperes per square foot.

8 oz. ammonium carbonate	60 grams
7 oz. lye	50 grams
13 1/2 oz. potassium cyanide	100 grams
13 1/2 oz. Rochelle salt	100 grams
1 gal. water	1000 c.c.

A half-hour's operation at 176 deg. F. and 62 amperes per square foot gave current efficiencies of 64 per cent. at the cathode and 47 per cent. at the anode, while a similar bath, except for the omission of the Rochelle salt, showed the same efficiency of deposition, but an anode corrosion of only 2 1/2 per cent. In these brass solutions Rochelle salt has the same beneficial effect upon anode corrosion as was previously noted for the copper solution. Its use in a hot bath solves the troublesome problem of the corrosion of brass anodes. The remarks concerning ammonium salts in the copper solution apply here, and they should be left out of the solutions containing lye, which are to be operated continuously at or near the boiling point.

The solutions above mentioned are only two out of many possible combinations of copper carbonate, zinc carbonate, cyanide and lye, which will operate at high current densities and yield good brass deposits.

The best method for the plater to use to obtain a cleaning and plating solution for brass,* suited to his particular needs, is to make up a cyanide copper solution containing lye, heat it at the temperature at which he intends to use it, and add zinc



Copper plate directly on rusty iron. Current, 25 amperes. Time, five minutes. Amperes per square foot, 240. Both ends of rod similar when immersed in plating solution.

This cleaning and plating solution is more difficult to control than the regular brass bath since the presence of lye is a disturbing factor. Lye, like cyanide, causes an increase in the proportion of zinc in the deposit, and since the presence of both of these substances is necessary for vigorous cleaning, this solution, unlike the regular brass bath, should contain much more copper than zinc.

The large amount of cyanide required by this bath in order to obtain a satisfactory color constitutes a serious objection to its use, and other combinations were tried. One of these, which gave an excellent deposit between 30 and 90 amperes per square foot consisted of—

4 oz. copper carbonate	30 grams
1 1/2 oz. zinc carbonate	12 grams

carbonate in very small quantities until the desired quality of brass is obtained. Increasing the quantity of lye in the original copper solution will lower the amount of cyanide and of zinc needed to yield a good yellow brass. Too little free cyanide will result in poor anode corrosion, even in the presence of Rochelle salt.

This procedure resulted in a good solution of the following composition:

2 5/8 oz. copper carbonate	20 grams
8 oz. lye	60 grams
7 oz. sodium cyanide	50 grams
1/4 oz. zinc carbonate	2 grams
1 gal. water	1000 c.c.

At 176 deg. F. and 36 to 56 amperes per square foot, this solution gave an excellent

*For the facts concerning the brass solutions the writer is indebted to Mr. R. E. Baker, scholar in chemical engineering during this year in the university.

deposit. Like the copper bath, it has remarkable cleaning power and in 8 minutes at 370 amperes per square foot produced a fine deposit through heavy rust.

Nickel

For a year past many experiments have been tried in the University laboratories in the hope of discovering a solution for cleaning and plating with nickel. At the outset this looked like an easy task, for it appeared only necessary to add lye to a hot solution of nickel sodium cyanide. On trial this solution cleaned effectively but deposited a mere color of nickel, too thin to be useful.

Glucose is one of several substances other than cyanide which prevent the precipitation of nickel solutions by alkalies. A hot nickel solution containing glucose and lye proved to be an effective electric cleaner, and gave a nickel deposit of a fine color, but like that from the alkaline cyanide solution, it was too thin to be of service. A half-hour's deposition at 52 amperes per square foot gave a current efficiency of only one-tenth of one per cent. The substitution of sodium carbonate for the lye did not change the result.

Failure to succeed with alkaline solutions directed attention to acid baths, and some degree of success has been achieved with the following solution:

13	oz. nickel ammonium sulphate	100 grams
2½	oz. sodium chloride	20 grams
1½	oz. sodium citrate	10 grams
¾ to 1	oz. citric acid	5 to 7 grams
1	gal. water	1000 c.c.

Exact proportions are not necessary, the only need being enough acid to cause a violent evolution of hydrogen on the cathode. The bath must be boiling, and current densities of 40 to 250 amperes per square foot may be used. This solution has no solvent power for grease, and for cleaning depends entirely upon the mechanical action of hydrogen. Although its cleaning power is far less than that of the copper and brass solutions, it has been possible to give a sheet brass twelve successive coats of nickel, each deposit being polished on a muslin buff with tripoli and immediately returned to the bath for the next coat. This solution may have some value for re-plating nickeled articles without stripping the original deposit. It is at present the only solution which the writer can offer as a combined cleaner and plater for nickel.

As containers for the copper and brass solutions iron or steel tanks should be used, with an exhaust hood over each to carry off the poisonous spray thrown up by the escaping hydrogen. Ample current should be provided in cables, tank rods, and sling wires. On account of the great evaporation from boiling solutions, it will probably prove most satisfactory to sacrifice something in rapidity of action by operating the baths below the boiling point.

There is a very general opinion that combined cleaning and plating solutions are only suited to thin deposits. This is a natural, though mistaken view. The combined solutions for brass and copper can be made to deposit metal more rapidly than is possible in any of the regular plating baths, and are particularly suitable for heavy deposits. Blistering of deposits on iron, which is a common complaint of platers using the regular brass and copper solutions, has never occurred with the combined baths.

The only question as to their general adoption would seem to be in regard to the more rapid fouling of the solution by the dirt, which in the old method was removed in the cleaning tank and so kept out of the plating bath. Whether this will outweigh the saving in time and labor made by the single bath is for the practical plater to decide. Should this fouling of the solutions prove a serious matter, the bulk of the dirt may be removed by a few seconds' immersion in a hot electric cleaner, and the cleaning-and-plating bath may then be regarded as only an extra-rapid plating solution that is guaranteed to give a deposit which, like that oft-quoted smile, will not come off.

As an addenda to the foregoing, I ought to state that in discussion with two members of the Chicago Branch I was informed that the combined cleaning and plating solution had been tried, but its use abandoned because of excessive consumption of cyanide. In view of these statements, it will be well for those who try this process to note carefully the cyanide consumption of this bath in comparison with that of the number of regular copper or brass baths required to do the same amount of work. Lowering the temperature will probably lessen cyanide consumption.

It may be well to call the attention of platers to the conditions under which most experimental work in plating must be per-

formed in the laboratories of educational institutions. In most cases research is not regularly provided for on the program, but must be done at such hours of the day or night as are left after all other demands upon one's time and energy have been met. Although an investigation may extend over many months before the final results are announced, the actual number of hours that the successful solution has been operated is rarely equivalent to a week's use under plating-room conditions. The college experimenter can rarely afford either the time or the material to give his supposed discovery the test of eight hours' operation daily for a period of six or eight months. It is not surprising then that laboratory processes often fail when put to the test of long-continued operation in the plating shop.

Yet it will never do for the plater to become discouraged and cease trying the processes and methods announced from the laboratory. Progress is possible only through the substitution of better methods, processes and solutions for those now in use. The chaff must be sifted from the wheat, and the plater is the man who must do the sifting. Having done this, it is his duty to report his results in print, not only to call attention to valuable processes, but to save scores of others from wasting their time in trying that which has proved useless. A single report of failure should not, however, be regarded as final. There are those in whose hands nothing new ever succeeds.

When aluminum was first introduced in brass foundry practice it was tried in all kinds of mixtures, to the sorrow of the founder, and it ultimately earned the title of the brass founders' curse.

And in later years, even after the foundryman had become wary, he was frequently careless, and in melting and casting aluminum would get it into the brass, where a very little would cause a vast amount of trouble; and it was considered a difficult matter to remove it, in fact almost impossible, and such spoiled brass became quite a problem to use up.

Summarizing conditions that have been created by war orders, *The Iron Age* says the great war business is gradually expanding.

Magnesium Made Electrolytically

Metallic magnesium is to be manufactured electrolytically by the Aviation Materials Corporation, 99 Cedar Street, New York, which has been incorporated under the laws of New York State. The plant will be located at Niagara Falls, N. Y., and it is expected it will be completed in June. It will operate under the patents of George O. Seward and F. von Kugelgen, who developed the process at the Virginia plant of the Virginia Electrolytic Company, Holcombs Rock, Va. The output is expected to be 10 tons of metallic magnesium per month. Besides being a constituent of some important alloys, magnesium is a beneficial addition to aluminum castings, as much as 2 per cent. often being used. An alloy containing 98 per cent. magnesium has been made by the inventors mentioned, which is lighter than aluminum and stronger. The average market price of metallic magnesium is \$1.50 per lb.

A Cheaper Substitute for Fuel Gas

The gases commonly employed in autogenous welding and cutting are oxygen, acetylene and hydrogen, all of which are expensive products. The average cost of oxygen throughout the United States is probably not less than \$0.025 per cubic foot measured at atmospheric pressure; the average cost of acetylene probably ranges from \$0.0075 to \$0.01 per cubic foot, and the cost of hydrogen may safely be placed at about the same figure. These figures are compiled by J. F. Springer in *Machinery*. Apparently no one has yet devised a system of oxygen manufacture that will enable this gas to be inexpensively produced. However, there appears to be a likelihood of heavy reduction in the cost of the fuel gas used in autogenous welding—not through a reduction in the cost of acetylene or hydrogen, but through the discovery of an adequate substitute for these gases. This substitute is a semi-natural gas obtained from the waste gas from oil wells, and is known as "gasol." It can be produced at about \$0.001 per cubic foot, and its heating capacity is even greater than that of acetylene. Other things being equal, this gas selling for \$0.0008 to \$0.001 per cubic foot should have a considerable market.

QUESTIONS AND ANSWERS

All communications under this head should be
addressed to the "Questions and Answers Editor"

Nickel Solution For Nickel Bath

QUESTION No. 46.—Please state ingredients and quantity for good nickel solution for nickel bath; also a good trisalyt of copper solution for depositing on wood plaster, plaster of paris and galvanic work.

ANSWER.—

1. Water 1 gal.
- Double ni. salt 8 oz.
- Single ni. salt 1 oz.
- Sal ammoniac 1 oz.
- Boracic acid 6 oz.

Use hot water in making up solution, but solution must be cold when plating.

2. The manufacturers of trisalyt, The Roessler & Hasslacher Chemical Co., will supply you with formulæ for using trisalyt on application.

Brands of Spelter and Analyses

QUESTION No. 47.—We would be very glad to have information regarding the different brands of spelter, with approximate analysis of each.

ANSWER.—The American Society for Testing Materials divides commercial spelter into four grades, the specifications for each grade being as follows:

High grade spelter shall not contain over

- | | |
|---------------|---------------|
| Lead | 0.07 per cent |
| Iron | 0.03 per cent |
| Cadmium | 0.05 per cent |

The sum of these impurities shall not exceed 0.10 per cent.

Intermediate spelter shall not contain over

- | | |
|---------------|---------------|
| Lead | 0.20 per cent |
| Iron | 0.03 per cent |
| Cadmium | 0.50 per cent |

The sum of these impurities not to exceed 0.50 per cent.

Brass special spelter shall not contain over

- | | |
|---------------|---------------|
| Lead | 0.75 per cent |
| Iron | 0.04 per cent |
| Cadmium | 0.75 per cent |

The sum of these impurities shall not exceed 1.2 per cent, and no aluminum is

allowable in any of the above spelters.

Prime western spelter shall not contain over

- | | |
|------------|---------------|
| Lead | 1.50 per cent |
| Iron | 0.08 per cent |

All the various brands of spelter on the market fall under some one of the above grades. High grade brands are very difficult to obtain at present. Such brands as Horsehead, Bertha, and Golden Rod, formerly used in the manufacture of high grade manganese bronze are now unattainable, while even Franklin, which runs as high as 0.50 per cent lead occasionally, is very difficult to obtain at present.

Formula Does Not Have Claimed Properties

QUESTION No. 48.—I have a formula that is said to be a malleable and non-corrosive metal when properly melted. I have tried several times and have been burned almost as often. The zinc or antimony is what apparently causes the trouble. It flares up.

Can you give me any idea as to how I should proceed to make this alloy? I have at my shop a small cupola, also crucible coke as well as tilting oil furnace.

This alloy calls for pig iron, 50 lb.; sodium, $\frac{1}{2}$ lb.; copper, $\frac{1}{4}$ lb.; antimony, $\frac{1}{4}$ lb.; zinc, $2\frac{1}{2}$ lb.

The directions state that by omitting the sodium and decreasing the quantity of zinc a softer iron is obtained. Also tell me what this formula means by sodium. There are so many kinds.

ANSWER.—We fail to see how the formula in question can possess any of the properties ascribed to it, and we strongly advise that no further attempts to make it be tried. It is dangerous to attempt to alloy zinc and cast iron, as they combine with explosive violence, and are of no value when alloyed. It is a mistake to assume there are many kinds of sodium; there is only one "sodium," and this is a metal very dangerous to handle by the uninitiated. It is probably very fortunate that the metal

itself was not available for this experiment and that one of its combinations, such as sodium carbonate, sodium chloride, or some other of its salts was used in its stead, as the addition of practically 1 per cent of sodium to molten iron could scarcely avoid being attended with disastrous results.

Instructions for Use of Tinning Flux

QUESTION 49.—Can you give us directions by which we may test our tinning flux? To explain our problem: We sometimes make our own flux by destroying all the zinc which the muriatic will eat up, and at other times we buy the flux ready made. It is simply a matter of price, but we note that there is a difference in the weight of flux we buy and that which we make, and it has been thought this may be caused by the addition of water, which experience teaches does not improve the tinning. We also have on hand a quantity of lead and zinc alloy. Is there any practical method of separating these metals?

ANSWER.—Probably the tinning flux that is purchased is different in composition to the one that you make yourselves, as there are a number of different formulæ for these fluxes. The zinc chloride made by "killing" muriatic acid with zinc always contains water owing to the fact that muriatic acid is an aqueous solution of hydrogen chloride, that is, hydrogen chloride or hydrochloric acid gas as it is sometimes called, is absorbed and held by water to form hydrochloric acid, muriatic acid, or spirits of salts as it is variously termed. Water absorbs about 450 volumes of this gas, and the resulting muriatic acid is of course largely water. After the acid is killed with zinc, both sal ammoniac and water are sometimes added, the proportions used consisting of 27 parts zinc chloride, 11 parts sal ammoniac, and 62 parts water. Mixed lead and zinc can be separated by melting the mixture and casting into ingots 2 in. square molded vertically in sand molds. During the slow cooling the heavier lead will collect at the bottom of the ingot, and when cool can be cut off the zinc end of ingot. The melting should be repeated several times until only the alloyed lead is left in the zinc.

Alloy For Cheap White Metal

QUESTION No. 50.—Please give me an alloy for cheap white metal that will take

a luster similar to nickel plate and retain its color and brightness.

ANSWER.—The following alloy will be found to meet the requirements stated:

Copper	55 lb.
Zinc	22 lb.
Nickel	12 lb.
Lead	10 lb.
Tin	2 lb.

To remove casting difficulties, add 2 oz. of aluminum to each 100 lb. of the alloy, but it is better to cast without the aluminum if possible.

There Is No Best Book

QUESTION No. 51.—Will you kindly advise what is the best book describing how to make cast manganese bronze?

ANSWER.—No books have been so far published on the subject of manganese bronze. The following formula is the one most generally followed:

Copper	56 lb.
Zinc	42 lb.
Steel alloy	2 lb.
Aluminum	$\frac{1}{2}$ lb.

The steel alloy is made as follows:

Wrought iron	18 lb.
80 per cent ferro-manganese	4 lb.
Tin	10 lb.

Melt the wrought iron and ferro-manganese together and the tin separately, and pour the tin into the molten alloy of iron and manganese, stirring vigorously. Cast into strips, or shot by pouring into water. To make the bronze, melt 46 lb. of copper, when very hot add the steel alloy and superheat until the latter is melted and incorporated with the copper, add the aluminum, then the reserve 10 lb. of copper to cool the metal and prevent too much loss of zinc. Stir thoroughly and pour sufficiently cool that the zinc will not flare, unless the skimmer is used. Bottom gate the molds and use heavy risers.

Standard On Plate

QUESTION No. 52.—Is there a standard for the amount of silver plate on German silver hollow ware of high grade? How many dwt. of silver should there be on a 12-in. tray, 6-cup teapot, 8-in. casserole, in order to make it high grade?

ANSWER.—There is no definite standard.

Brass Plating Iron Nails

QUESTION No. 53.—I have some iron nails to be brass plated. I have tried them in

my brass, but they come out dull. I would like to have you tell me how I can get the same color as samples. They are iron, plated brass.

ANSWER.—The burnishing will be best accomplished by any burnishing machine sold by makers of repute. Consult columns of BRASS WORLD.

Will They Resist Rust?

QUESTION No. 54.—What particular value has copper over iron before nickel plating? Will iron, copper, and nickel plated goods resist rust better than nickel alone when work is handled much?

ANSWER.—The coppering of iron before nickeling assists the nickel to remain longer on the iron, otherwise peeling of the nickel deposit is liable to take place.

Right Way to Tin

QUESTION No. 55.—Please tell me the right way to do tinning. Should it be block tin with heating, or by plating, and what is to be used for same?

ANSWER.—Melt the tin and immerse the clean article into it. Shake off all excess tin.

How To Handle Hollow Ware

QUESTION No. 56.—Would you kindly tell me the right way to strip silver-plated hollow ware soft metal?

ANSWER.—Reversing the current is the best manner to strip your silver.

Volumetric Analysis of Lead and Zinc in Silver Alloys

QUESTION No. 57.—Can you tell me of a method of volumetric analysis of silver alloys to detect lead and zinc? Is there any electrolytic method of detection?

ANSWER.—Dissolve 1 gram sample in 10 c.c. of nitric acid, boil to remove brown fumes, then add 15 c.c. of sulphuric acid, and evaporate to fumes of sulphuric anhydride. Cool, dilute to 100 c.c. Filter off precipitated lead sulphate. Retain filtrate. If the amount of lead is small it is advisable to weigh as lead sulphate. If it is desired to determine it volumetrically the following scheme works well:

Wash the lead sulphate into a beaker with 75 to 100 c.c. of acid ammonium acetate solution. Then determine the lead by

the bichromate method as described in any standard books on quantitative analysis.

The filtrate from the lead sulphate contains the silver and the zinc. It is necessary to remove the silver before trying to titrate the zinc. Add hydrochloric acid a little at a time until a clear solution is obtained. Filter off the silver chloride and determine the zinc in the filtrate by the potassium ferrocyanide method.

For electrolytic separation of the above metals refer to Classen (Hall), work on analysis by electrolysis.

QUESTION No. 58.—Will you give me the formula for a very hard dead black called, sometimes, an acid black? It is used on scabbards, etc., use in my business, not japaning.

ANSWER.—Would suggest that you try the following:

Water	1 gal.
Denatured alcohol.....	5 oz.
Bismuth chloride.....	2 oz.
Copper chloride.....	1½ oz.
Bichloride of mercury.....	2½ oz.
Hydrochloric acid.....	6 oz.

Use boiling hot. If, after this treatment, the article is not black enough, boil for some time in water.

Formula For Treating Alloy

QUESTION No. 59.—We are making a yellow alloy of the following composition: Copper, 59 per cent; zinc, 40 per cent; tin 1 per cent; and 1 ounce of aluminum to each 100 lb. of alloy. In this mixture we wish to put one third new metal of the above formula, one third borings and one third gates of this same mixture, and we would like to know the best method of making and casting the alloy.

ANSWER.—Take an old crucible and chop off the bottom with a hatchet by nicking it all around gradually until cut through; this will produce a ring several inches deep which should be the same size as the crucible in which the melting is to be done. Coke up the latter crucible in the furnace in the usual manner and place the ring on top. The fuel should not be higher than the top of the melting crucible, the ring which acts as a hopper being free of coke. Charge into the empty crucible as much borings as will fill it half full, on the borings put the copper of the new metal charge, then pile in gates until the hopper

is full and pack in between several handfuls of small charcoal. Close the furnace and allow the charge to become melted, then add the aluminum, zinc and tin of the new metal in the order named, stir thoroughly, and add the remainder of the borings and gates, if any, also add more charcoal if needed. Keep careful watch on the metal at this juncture and do not allow it to flare strongly, but if it does add an extra gate to cool it. The metal should be quiet in the furnace but flare when stirred, at which point remove it from the fire, skim and pour into the molds. When skimmed and while pouring the alloy should not smoke, unless the castings are very thin.

Oxidizing Composition Castings

QUESTION No. 60.—We have a number of composition castings to be oxidized, and we would like to do them ourselves, if possible. We are sending a composition rod, one end of which has been oxidized. Can you inform me how this is done?

ANSWER.—There are several ways of doing this. Probably the best is the black nickel (BRASS WORLD, June, 1908); then coat heavily with black lacquer, and when dry buff to give a high luster. It can also be done by oxidizing with ammonia and carb. of copper, dip, then lacquering. It can be silvered first and then oxidized with ammonia and carb. of copper, then lacquered. We would recommend the black nickel as the most satisfactory.

Pouring Temperature of Babbitt

QUESTION No. 61.—Will you please state how we can judge the temperature of babbitt metal in pouring large boxes.

ANSWER.—The pouring temperature will of course depend largely upon the composition of the babbitt and the thickness of the metal to be cast. Generally, in the case of a tin babbitt, the metal should be hot enough to just char a stick of wood when thrust into the metal, but not hot enough to violently bubble. The fluidity of the metal will be improved by the addition of a little rosin just before pouring.

Is There A Surplus Of Copper?

QUESTION No. 62.—We have a babbitt formula as follows:

Lead	74 per cent
Tin	16 per cent
Antimony	8 per cent
Copper	2 per cent

From a metallurgical standpoint, do you believe this specification contains a surplus of copper, or, in other words, would the copper in this formula cause the metal to be sluggish?

ANSWER.—The copper would certainly have a tendency to make the alloy sluggish on account of the high percentage of lead. We suggest that the copper be omitted and 2 per cent be added to the antimony. The following alloy would be more suitable:

Lead	80 per cent
Tin	5 per cent
Antimony	15 per cent

QUESTION No. 63.—We would like to obtain the formula for an acid resisting alloy suitable for use in dye houses. A test bar will have to be first submitted, and we would like the mixture in proportions for a heat of 100 lb., and also for a heat of approximately 2 lb.

ANSWER.—We recommend the following alloy, which is used extensively for the purpose stated:

Copper	89½ lb.
Tin	10 lb.
15 per cent phosphor copper	½ lb.

For a smaller heat simply use ounces of copper, tin and phosphor copper, instead of pounds. This will make a heat of 6¼ lb., and is as small as can be weighed conveniently on the usual foundry scales.

Which Is Best?

QUESTION No. 64.—In electro-galvanizing of iron and steel couplings (threads only), which is the best cleaning solution, caustic soda or sulphuric acid?

At what temperature should the plating solution be kept?

We have trouble in getting couplings clean. When couplings are being "tapped," mineral and vegetable oils are used for a lubricant for the taps. What voltage? What distance should anodes be from couplings? Anodes are suspended inside of couplings. Does wooden tank lined with tar pitch injure the plating solution? Would a steel or iron tank be better?

ANSWER—

1. Caustic soda is the best.
2. About 100 deg. Fahr.
3. Voltage 1½ to 3½.
4. Best to judge by experiment.
5. No—when no cyanide is present. If cyanide is present tar interferes.
6. No—wood is preferable.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES

Bridgeport—Meets on the third Friday of each month at 260 John Street, Bridgeport, Conn. Secretary Nelson Barnard, 858 Howard Avenue, Bridgeport, Conn.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, S. Wroblewski, 1486 Elmwood Avenue, Buffalo, N. Y.

Chicago—Meets fourth Saturday of each month at 8 P. M. at Western Building, Randolph and Michigan Avenue. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Avenue, Cincinnati, Ohio.

Cleveland—Meets last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Avenue, Cleveland, O.

Dayton—Meets first Wednesday of each month at Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 First Street. Secretary, B. E. Miller, 543 Townsend Avenue, Detroit, Mich.

Indianapolis—Meets last Saturday of each month at the Denison Hotel. Secretary, Arthur Nelson, 1617 Shelby Street, Indianapolis, Ind.

Milwaukee—Meets second Wednesday of each month at Marquette University. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 West Madison Avenue, Irvington, N. J.

New York—Meets fourth Friday of each month at 258-262 Pearl Street, New York City, at 8 P. M. Secretary, Wm. Fischer, 345 East 23d Street, New York.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Rochester—Meets second and fourth Friday of each month at University of Rochester. Secretary, C. V. Haring, 603 Dewey Avenue, Rochester, N. Y.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, F. Rushton, 4405 Blair Street, St. Louis, Mo.

Toledo—Meets every Wednesday at Toledo University. Secretary, James E. Nagle, 209 Navarre Avenue, Toledo, Ohio.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Society Notes

The June meeting of the Toronto A. E. S. Branch was held in Occident Hall June 24, President Magill presiding over a record attendance, the past and next conventions being the biggest topics of the evening. The election of officers for the coming year resulted as follows: President, Wm. J. Salmon; vice-president, John Acheson; secretary-treasurer, E. Coles; librarian, J. A. Magill; trustees, W. W. Wells, Jr., T. Charles Orr and W. S. Barrows; sergeant-at-arms, John Young.

The report of the Dayton convention by the president, who was delegate from the Toronto Branch, proved interesting and gratifying, and was received with great approval. With the supreme presidency, the 1916 convention, and an honorary membership in the Supreme Society, Toronto Branch can claim a fair share of the "plums." With characteristic promptness the supreme president announced progress in arranging for quarters for the convention, and outlined a suggestion for plans for holding it.

Our exuberance may be forgivable, but knowing him as we do, we cannot but feel that with W. S. B. at the helm and the right kind of support, the coming year should be a banner one for the A. E. S.

Mr. Wilson of the Technical School addressed the meeting, thanking members for the honor of being elected to the supreme body and expressing the desire to help make the Toronto convention a success. Ex-President Magill and President Salmon spoke briefly, the one thanking the members for past support, and the other asking a continuance of like support during his term of office. A discussion on nickel plating used auto radiators brought a very interesting meeting to a conclusion.

The regular monthly meeting of the New York Branch A. E. S. was held June 25. The newly elected officers were installed, the report of delegates to the annual convention was received, and changes in the constitution considered. A demonstration of cobalt plating was given by Mr. Charles Buchanan. It was decided to hold but one meeting in the month during July and August, the day selected being the fourth Friday of the month.

The St. Louis Branch of A. E. S. has elected the following new board of officers:

President, H. H. Williams; vice-president, H. J. Richards; secretary and treasurer, F. Rushton; librarian, C. H. Weygandt; board of managers, E. J. Musick, J. T. McCarthy and G. Lamkemeyer.

The July 24 meeting will be held in Belleville, Ill., on invitation of the members of the branch residing thereabouts.

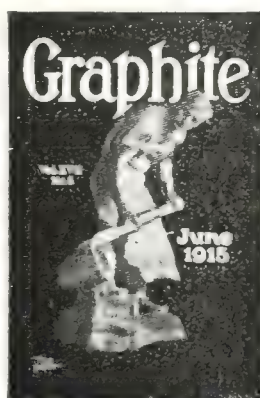
At the meeting of the American Foundrymen's Association at Atlantic City in September the papers to be read follow: *Résumé of Advances in Foundry Practice*, by Richard Moldenke. *Application of Various Types of Molding Machines to Different Classes of Work*, by J. J. Wilson and A. O. Backert. *Time Studies on Molding Machines*, by H. K. Hathaway, Philadelphia. *Functions of Sand Binders*, by H. M. Lane, Detroit. *The Reclamation of Molding Sand*, by W. M. Saunders and H. B. Hanley. *Relation of the Foundry Foremen to the Manager*, by S. V. Blair. *Manufacture and Constituents of Pig Iron and the Essentials in the Purchase of This Material*, by O. J. Abell, Chicago. *Pouring Systems for Gray Iron Shops*, by H. Cole Estep. *Fuel Oil Cupolas*, by Bradley Stoughton, New York City. *Thermal Reactions in Melting Gray Iron*, by Dr. Joseph Richards, Lehigh, Pa. *The Inspection of Automobile Castings*, by C. B. Wilson, Pontiac, Mich. *Defects in Gray Iron Castings and Remedies for Them*, by Herbert Ramp, Cincinnati. *The Value of the Vibratory Test in Steel Foundry Practice*, by Lloyd Uhler, Pittsburgh. *The Particular Application of the Converter in the Manufacture of Steel Castings*, by C. S. Koch, McKeesport, Pa. *Notes on Electric Furnace Construction and Operation in the Steel Foundry*, by Mr. Gray, United States Steel Corporation, New York City. *Correct Proportions and Essentials in Checker Design for Open-Hearth Furnaces*, by W. A. Janssen, Bettendorf, Iowa. *Causes for Shrinkage Cracks in Steel Castings*, by William Bossinger, Marion, Ohio.

A decree has been issued prohibiting the exportation and re-exportation of tin from Portugal to foreign countries. The decree also prohibits the transit and transshipment of the metal (when intended for foreign countries) if the consignments are described in the manifests or bills of lading as being "to order."

Trade Publications

"Practical Shop Mechanics and Mathematics," by James F. Johnson, Supt. of State Trade School, Bridgeport, Conn.; 137 pp.; 81 illustrations; \$1.00.

"Autogenous Welding," the name of the publication issued by Davis-Bournonville Co. in the interest of the newest welding, has issued its Panama-Pacific Exposition Number, and a right good piece of work it is. All interested in gas welding are sure to read this issue and enjoy the illustrations. The company is very liberal in making a free gift of such good work.



The June issue of *Graphite*, the house organ of the Joseph Dixon Crucible Company, portrayed upon its cover a splendid reproduction of "The Pour," a bronze statue at the offices of the Damascus Bronze Company, Pittsburgh, Pa. "The Pour" was modeled by H. Mueller, and imported from France. Though efforts have been made to trace its origin, no further knowledge of it has been obtained. *Graphite* contains its usual miscellany of good things to read.

In a catalog just received from the Hanson & Van Winkle Company, Newark, N. J., is illustrated and described a very complete line of electroplating machinery. This is one of the most complete and comprehensive catalogs on this subject and deals particularly with mechanical plating apparatus for doing plating in bulk.

The book is very well illustrated with full page half-tone cuts, showing the detailed construction of the various apparatus in a very effective manner.

A number of different types of mechanical plating devices are shown adapted for plating articles in quantity, such as wire in coils, chain, hoops and other forms of metal in hoop or circular shape. Also for the plating of small articles such as screws, bolts, nuts, etc., as well as wire, hoop iron, wire cloth, conduit pipe, rods, etc. An au-

tomatic lacquering machine is also included. Anyone interested in mechanical plating devices should write for a copy of this catalog.

Trade Notes

Great Eastern Metal Refining Company, capital \$50,000, has been incorporated in Delaware; headquarters, Philadelphia.

The Monongahela (Pa.) Clay Mfg. Company has been awarded the contract for furnishing the material for the new \$3,000,000 zinc plant at Donora, Pa.

Mr. Andrew Allan, head of the metal firm of Andrew Allan & Son, 486 Greenwich Street, New York, died July 6 at Asbury Park, where he was passing the summer. Mr. Allan, who was seventy-eight years old, lived in Jersey City.

Zinc has gone up to such high prices that a labor strike began in the Missouri mines July 5, and thirty mines are closed.

The export of zinc metal for the ten months would seem to bear out the contention of zinc miners that the increased demand alone has been responsible for the advance in the price of zinc metal from about five cents to twenty-five cents per pound and a corresponding increase in the value of zinc ores from around \$40 to \$139 a ton. In round numbers 21,250,000 pounds of zinc and zinc products went abroad in the ten months ending April 30, compared with approximately 400,000 pounds a year ago. And these figures do not include what has been used in munitions of war manufactured here and exported.

The New Jersey Zinc Company, which employs more than 2000 men, has increased the wages of all its employees 10 per cent. The capital stock has been raised from \$10,000,000 to \$35,000,000.

The Buckley Welding Works has been incorporated in Connecticut with \$16,000 capital. Home office, Waterbury. Incorporators, E. N. O'Brien, W. A. Buckley and F. J. Quinn.

The Stege-Rindt Plating Company, Louisville, Ky., filed articles of incorporation, with a capital stock of \$11,000. The incorporators are Carl and Louis Rindt and George W. Stege. The corporation will manufacture metals of various kinds.

Schoen-Badkin Company, New York, brass and metal work, a petition in bankruptcy; liabilities, \$3,926; assets, \$2,605.

That there is a great shortage of brass existing in Waterbury, Conn., which promises a menace if not remedied in the immediate future. Strict orders have been issued to heads of departments cautioning them to use every effort in the savings of brass scraps, which ordinarily were handled with disregard and swept into scrap cans, and to hunt every nook in the factories for the purpose of saving any scrap brass which may be lying idle. In the Waterbury Manufacturing Company receptacles have been attached to the benches and machines for the purpose of catching the scrap.

The Wayne Brass Foundry Company, Pittsburgh, Pa., are making a large addition to plant.

M. C. and I. N. Stone have purchased the lease of the Paragon Brass & Mfg. Company's building in Cleveland, O.

Articles of incorporation of the Interstate Zinc Company, St. Paul, Minn., capital \$100,000, have been filed to-day. The incorporators are Louis J. Rothschild, William Foulke and A. W. Summerfield.

Manning-Bowman Company, Meriden, Conn., has bought the plant of the Vacuum Specialties Companies, Vineland, N. J., whose specialty was metal vacuum bottles. The industry will be continued by the purchasers.

The Parsons Metal Products Company, Indianapolis, has been incorporated, capital \$25,000; metal products; directors, W. O. Parsons, G. C. Holtman, H. E. Parsons.

The Metal Toy Mfg. Company, New York City, has incorporated with \$50,000.

The Toledo (Ohio) Electro Plating & Stamping Company has been incorporated for \$50,000. The company has been in business on Grand Avenue.

The Ohio Pail Company, Chardon, Ohio, is enlarging its factory, and will install machinery to make tin linings for paint pails.

The J. R. Rich Company, Asheville, N. C., has sold the sheet metal and tin departments to R. P. Johnson, who will continue the business in a broader way.

The plant of the Patterson Rubber Company in Lowell has been purchased by Ralph P. Phillips of Boston, representing a company engaged in manufacture of brass. The new concern takes possession of the property at once.

The McKeesport (Pa.) Tinplate Company will make extensive additions to its Portvue mills. Present capacity is to be doubled.

Thermit when packed in tight metal containers may be transported on steamers carrying passengers, and ignition powder used in connection therewith may be transported on steamers carrying passengers under the same conditions as gunpowder. This is a modification of a previous ruling that thermit is a dangerous commodity and shall not be transported on steamers carrying passengers.

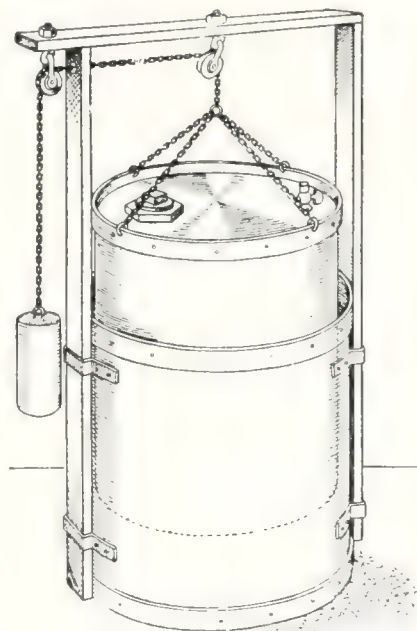
A complete reorganization in the Bayonne Casting Company, Bayonne, N. J., has followed the withdrawal of W. E. Oakley. J. F. McNamara has become general manager, and already plans and changes have been put in operation that will assure patrons of the company very prompt, efficient and satisfactory service, even superior to that they have been accustomed to in the past.

Tanks for Supplying Air at Low Pressures

In soldering metals, or melting them in small amounts, compressed air at low pressures can be used to advantage in connection with gas burners. Power blowers are ordinarily used to obtain the necessary pressure, but a good, cheap substitute for small work can be made from two heavy cans, as illustrated. Two sizes of cans should be obtained, so one may freely pass within the other. They should be open at one end, but otherwise air and watertight. The larger, or stationary, tank should be provided with four strips of metal placed in sets of two on directly opposite sides and fastened with rivets or solder. The strips of metal are formed to fit two wooden strips used as uprights for a frame which is connected at the top by a crosspiece provided with two pulleys, one midway between the uprights, and the other suspended from an extension on one side. The upright on this side is drilled for a cable hole in line with the tops of the pulley wheels.

Two openings are made through the closed end of the smaller or movable tank, one to serve as air outlet and the other as an inlet. The outlet is made sufficiently large to fit an ordinary gas cock, which should be soldered in place, and connected to the gas burner with a suitable rubber hose. The inlet opening is cut to fit a

suitable pipe flange, which is soldered or riveted in place and fitted with a plug to open or close it. Four chains or cords are evenly spaced and connected to the rim of the movable tank, to hold it in an inverted position. They are fastened at their loose ends to the weight cord, which passes over the pulleys to a regulating weight, used to govern the descent of the movable tank.



A Low-Pressure Air Tank to Supply Air in Burners for Working Metals Having a Low Melting Temperature

To get higher pressures than produced by the unbalanced weight of the tank, additional weight may be added on the tank.

To operate the device *Popular Mechanics*, to which source we are indebted for illustration and part of the article, says "the lower tank is filled three-quarters full of water. The movable tank with its outlet open is placed in its upper position, and then closed up with the plug, and connected to the gas burner by a rubber hose. When the gas cock is opened, the excess weight of the tank will cause it to descend, forcing the air through the rubber hose to the burner. When no more air can be forced out of the upper tank, the outlet must again be opened and the tank raised to its upper position. With the outlet again plugged, the operation will proceed as before."

The article on "Plating Aluminum with Nickel," a translation from the French of J. Carnac and E. Cassilly, that was published in the June BRASS WORLD, through inadvertence was not credited to *The Engineering Magazine*.

FROM AMBER TO DYNAMO

Part VIII: Multiple Circuits and the Use of Rheostats

By H. E. Willmore, Jr., B. S.

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The problem of determining the division of power (and hence energy) between the branches of a complex circuit resolves itself into a problem of determining the division of current at the junction point of two or more branches. The current leaving the battery, Fig. 15, is divided between the four branches. The potential difference of the battery or dynamo terminals is applied to each of the branches at their junction points P and N . This is a simple case. Since the power supplied to each branch is equal to the product of the voltage and the current, the division of power in this case is dependent upon the division of current. The branches are in reality separate circuits to which equal voltages are applied. If it were not for the switching on and off of the tanks, the shifting of rheostats which are connected with them, and the changing of the amount of pieces in the tanks, this voltage would remain nearly the same at all times. With batteries increases in total current output always mean decreases in external voltage. This would be true even though polarization tendencies were entirely eliminated, and is due to the resistance offered by the battery electrolyte. If the voltage is measured between the terminals of a cell on open circuit (not connected to any load) and again on closed circuit, the value in the first measurement will be found to be higher than in the second. The explanation follows. Only very small currents are required to operate a voltmeter. Therefore, when the voltage of a battery is measured on "open circuit" there is only a very small current flowing, and the reading obtained represents approximately the potential of contact between the electrodes and the electrolyte (See Part IV). On the other hand, when a current is flowing through the cell, the resistance of the electrolyte and the electrodes causes a drop in voltage such as occurs in the conductors of the external circuit, hence the voltage of the terminals of the battery or cell is lower

on closed circuit. The difference between the voltage readings on closed and open circuit divided by the number of amperes flowing while the circuit was closed, gives the ohms internal resistance of the battery.

It will be seen that when batteries are used, the addition of a tank full of work will cause an appreciable drop in the voltage applied to the branches. Here we have a very good use for rheostats in connection with plating: to regulate the flow of current through each tank with changes in the available voltage. A drop in available voltage means a drop in the value of the current in each branch, and hence a shifting of all rheostats to decrease the resistance of the branches and bring the currents back to the desired value. One way of compensating for the falling off of battery voltage is by the addition of more cells, but this does not make the battery more desirable. A similar drop in voltage with increase of load really occurs in the dynamo, but as will be seen later dynamos may be so built as to correct this automatically with increase or decrease of load. By this I mean that although a power loss and a voltage

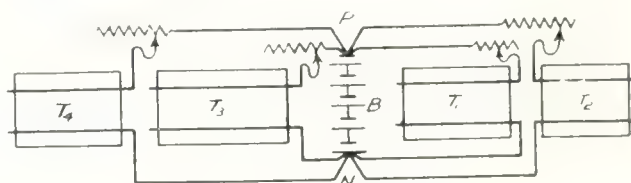


FIG. 15

drop occur inside of dynamos, the external voltage of the dynamo may be made to remain practically constant by making the internal voltage, (that voltage corresponding to the contact voltages in a battery), increase and decrease with the current output.

In any case the current flowing in one of the branches of the circuit shown in Fig. 15 at any given instant is dependent upon the total resistance of the branch and the value of the voltage at that instant. This current measured in amperes is equal to

the voltage divide by the resistance of the branch in ohms, and the distribution of power over the length of this branch depends upon the resistances of the various sections, as was previously explained. Now the total resistance of the branch may be changed to suit the requirements of the plating tank by increasing or decreasing the length of conductors leading to the tank, by changing the cross-sectional size of the conductors, or by substituting a material which offers a greater or less resistance for the same size and length. The upper

of a conductor. This is just what we should expect from our conception of current as moving electrons being passed from molecule to molecule or atom to atom in solid conductors, and as electrons carried by atoms through electrolytes. The longer the path of these electrons through any given material the greater the resistance, and the larger the cross-sectional area the less the resistance. The exact value of the resistance of any given length and cross-section of wire depends upon the material from which it is made and upon the temperature

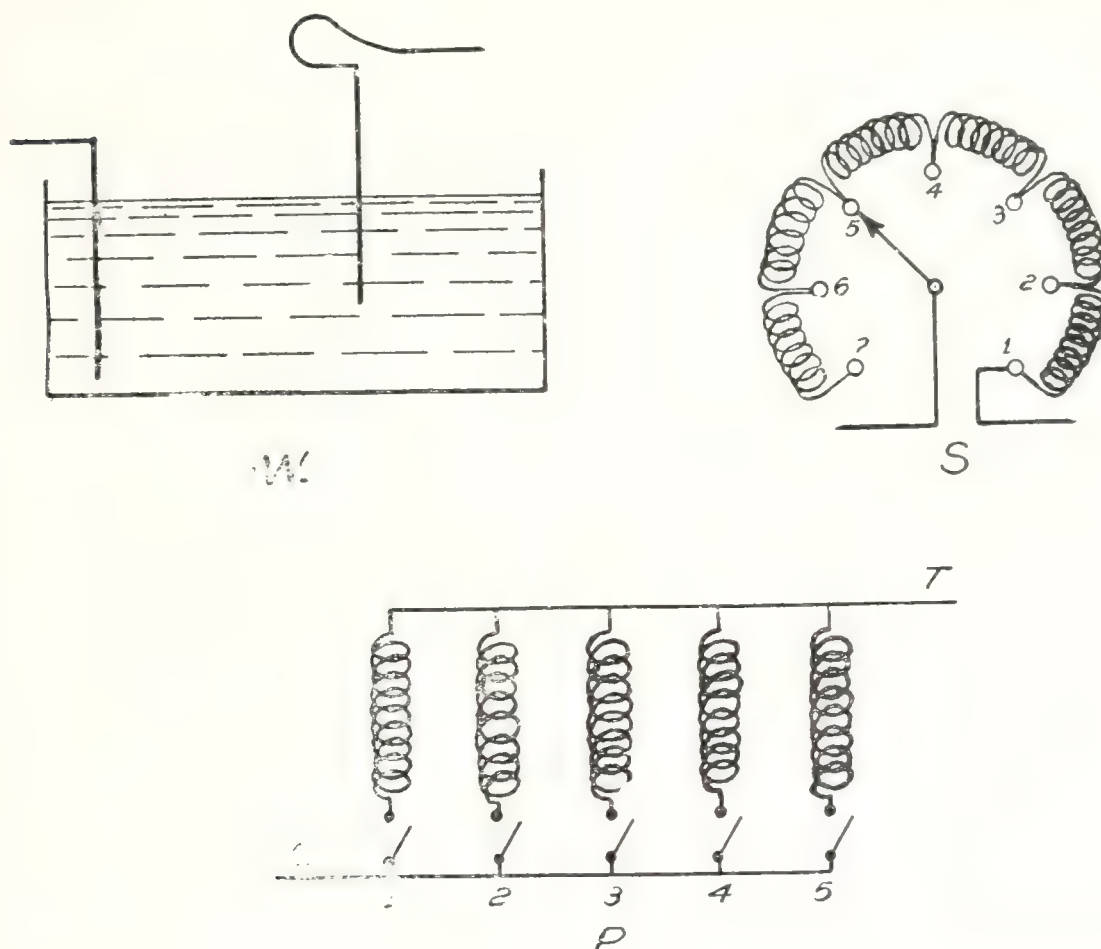


FIG. 16

limit of voltage which can be obtained at the plating tank is, of course, the voltage of the battery or dynamo. Here is another and more important use for rheostats: to regulate the amount of current supplied to the various tanks from a single source of potential. The many forms of rheostats with which the plater is familiar accomplish the regulation of current through some combination of the above methods of regulating the resistance.

Resistance varies directly with the length and inversely with the cross-sectional area

of the conductor. Under constant temperature the above relations are stated in the equation, $R = k L/A$ in which R represents resistance, L the length, A the cross-sectional area, and k the constant for a given material and temperature. The values of k for a number of metals is given in Table II, together with the decimal increase in resistance for a rise in temperature of 1 deg. C. The unit of metal for which the values of resistivity (k) are given is the circular mil-foot. This is equivalent to a wire 1 ft. long and having a circular cross-

section 0.001 in. in diameter. Values of k are in ohms per circular mil-foot.

An inspection of Table II reveals some interesting facts. The single pure metals, while their resistivities cover a rather wide range, all have approximately the same temperature coefficient (0.004). On the other hand, the resistivities given for alloys run much higher than those given for pure metals and have widely different temperature coefficients.

The conductors used for rheostats are usually alloys in which the metals are so selected and proportioned as to have a high resistivity, a low temperature coefficient of resistivity, and to be capable of withstanding high temperatures without burning or deteriorating. A low temperature coefficient is not absolutely necessary to rheostats used with plating baths, but it is desirable to have the resistance of the rheostats remain approximately constant after they have been set for a batch of work. The temperature coefficients of electrolytes as a rule are such as to cause a decrease in the resistance of the electrolytes and therefore has a slight tendency to counteract the increase in resistance of the rheostats caused by heating from the current passing through them. However the increase in temperature of the plating bath due to the flow of current through it is never very large.

Figure 16 shows the schemes of three different rheostats. W is an emergency water rheostat made from a tank, two iron plates and a weak electrolyte of common salt solution. The electrolyte is the resistor. By bringing the plates closer together the effective length of the resistor is shortened. Lifting the plates partly out of the electrolyte decreases the effective sectional area of the resistor. In the former case the resistance is decreased while in the latter it is increased. This of course is not a practical rheostat for continued service. It is included here to show the principle of changing the resistance by changing the length or section of the conductor.

S represents a rheostat in which a number of resistors are placed in series and the resistance of the unit is changed by switching in a greater or less number of resistors. This is equivalent to increasing or decreasing the length of the conductor. In some types this is also equivalent to increasing or decreasing the size of the conductor. These

types have resistors made from conductors of larger sectional area between points 1 and 2 than between 2 and 3, and larger between 2 and 3 than between 3 and 4, etc. The reason for doing this is simple. Suppose S to be connected to a tank as shown at R in Fig. 13. When the movable arm is on point 2 the current flowing through the circuit is greater than when switched to any other point except 1. Now suppose each resistor to have 0.01 ohms resistance. The current flowing through resistor 1 to 2 is a maximum when the arm is on point 2. Hence this resistor should be so designed that the energy expended in 0.01 ohm resistance with this maximum current will not overheat it. The sectional area of 1 to 2 should be greater than for any of the other resistors, and this requires a greater length if it is to have the same resistance as the other resistors. By making the sectional areas of the resistors vary according to the currents which they have to carry, the intensity of heat radiation from all of the resistors may be kept nearly the same. In other words the surface areas are so proportioned as to distribute the heat and cause a uniform intensity. If only the size of the conductors are varied and the length kept the same, their resistances will vary, and the amounts of energy expended will be different for each resistor. From point to point the adjustment of resistance is finer when the resistance is nearly all cut out.

Fig. 16 P gives the working principle of a rheostat in which the resistors are connected in parallel. The resistances 1 to 5 are graduated so that 1 has the greatest resistance and the smallest cross-section, and 5 has the least resistance and the largest cross-section. By closing the switches one at a time it is possible to obtain five different values of resistance between the bus-bars T and L . If a lower resistance than 5 is required combinations of two or more resistors may be used. Thus if switches 1 and 5 are closed the result is the same as increasing the diameter of one of the resistors without materially changing its length. This type of rheostat gives greater flexibility and finer adjustment than S unless the latter is made with a great many contact points.

The current in passing through two or more resistors of P is divided inversely as their resistances. Suppose two wires of

different diameters, of the same length and made from the same material are connected in parallel as the wires of *P* are connected when the switches are closed. The current passing through these wires will divide in the proportion of the sectional areas of the wires, because the resistances are inversely proportional to these areas. If the wires are of unequal length the current will be divided inversely as the resistance of the two wires, but these resistances will not be determined by the sectional areas alone. This is the principle of all parallel circuits; the greatest current flows through the branch offering the least resistance. In Fig. 14 the same rule holds. This circuit is complicated, however, by the number of dividing points. The voltage applied at the dividing points *P*₂ *N*₂ is not just the same as at *P*₁ *N*₁. This is due to the voltage drop in *P*₁ *P*₂ and *N*₁ *N*₂.

TABLE II.
Resistivities at 20° C.

	Ohms Resistance per Circular Mil-Foot.	Increase of Resistance per Ohm for 1° C. Rise in Temperature
Silver	9.5	0.00382
Copper (annealed)....	10.3	0.0039
Gold (annealed).....	13.5	0.0037
Aluminum (annealed)..	*18.5	0.0039
Iron Wire (annealed)..	*58.0	0.0045
Nickel	75.0	0.0035
German Silver, 18 per cent Ni.....	*220.0	0.00031
German Silver, 30 per cent Ni.....	*375	0.00025
Manganin	286	*0.00003
Constantan (Cu-Ni)...	300	0.000005
IaIa (Cu-Ni).....	280 to 310	*0.00001
Nichrome	575	0.00043

*Indicates wide variation.

Etching Reagents

O. F. Hudson's paper before the Iron and Steel Institute names some of the principal reagents which have been found especially suitable for different metals and alloys:

Copper.—Ammonia (sp.gr. 0.88, diluted 1:1 with water), ammonium persulphate (10 per cent aqueous solution), bromine (followed by a wash with ammonia), copper-ammonium chloride (5 grams of copper-ammonium chloride in 100 c.c. of water, add ammonia until precipitate just dissolves).

Brasses.—Ammonia, ammonium persulphate, copper-ammonium chloride, electrolytic etching, ferric chloride (slightly acidulated with HCl), chromic acid (saturated or nearly saturated solution), nitric acid (strong acid, followed by water), Tinoféef's reagent (94 grams HNO₃ and 6 grams

Cr₂O₃, a few drops are used in 50 c.c. of water).

Bronzes.—Ammonia, ammonium persulphate, ferric chloride.

Copper-Aluminum Alloys (Aluminum Bronzes).—Ammonium persulphate, ferric chloride, copper-ammonium chloride, nitric acid.

German Silver.—Ammonium persulphate, ferric chloride.

Nickel-Copper Alloys, Monel Metal.—Electrolytic etching.

Gold and Rich Gold Alloys, Platinum and Its Alloys.—*Aqua regia* (dilute, 1 part HNO₃, 5 parts HCl, 6 parts distilled water, used at 15 deg. C.).

Aluminum and Light Aluminum Alloys.—Caustic soda, hydrochloric acid, hydrofluoric acid (1 part fuming HF to 10 or 20 parts of water, clear after treatment by a few seconds' immersion in HNO₃).

Lead, Tin and Their Alloys (White Metal, etc.).—Chromic acid in nitric acid, ferric chloride, hydrochloric acid, nitric acid, silver nitrate (5 per cent solution).

Zinc and Alloys Rich in Zinc.—Caustic soda, iodine (1 part iodine, 3 parts KI and 10 parts water).

Aluminum in Minerals

A test for discovering the above is given in the *Mechanical World*. Take a very small amount of the powdered mineral and place together with about ¼ c.c. of crystalline ammonium fluoride and four or five drops of concentrated sulphuric acid in a platinum crucible. The mixture is gently heated to drive off the acid while stirring with a platinum wire, and then heated to bright redness for a moment. Examined under the microscope the residue exhibits hexagonal crystals of corundum if aluminum be present, some of the crystals being colored yellow if iron is also present. Very small six-sided plates, colored green, are given by chromium. Hexagonal crystals are not yielded by manganese, nickel and cobalt.

From John Given, Los Angeles, Cal.: "I have forwarded my subscription for the BRASS WORLD. * * * I do not want to drop your paper, as it is worth a great deal more than it costs."

A Short Outline of the Principles of Chemistry for Electroplaters

By ALLAN J. FIELD

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Separation of the Groups

In previous articles* tests were given for the identification of the metals in the different groups. These tests showed that each metal gave some reaction that distinguished it from the other metals. In the same manner each group of metals reacts with a certain reagent which separates it from the other groups. In analyzing a solution, a salt or alloy, the first step is to precipitate the different metals in groups, then the groups can be further separated into the metals they contain.

First Group

The first group consists of silver, lead and mercury (mercurous). They are precipitated with hydrochloric acid as silver chloride (AgCl), lead chloride (PbCl_2) and mercurous chloride (HgCl).

Second Group

Consists of mercury (mercuric), copper, tin and lead. They are precipitated with hydrogen sulphide gas as mercuric sulphide (HgS), copper sulphide (CuS), stannic sulphide (SnS_2) and lead sulphide (PbS).

Third Group

Consists of iron and aluminum. Ammonium hydrate is used to precipitate them as ferric hydrate $\text{Fe}(\text{OH})_3$, and aluminum hydrate, $\text{Al}(\text{OH})_3$.

Fourth Group

Consists of nickel, zinc and manganese. They are precipitated with ammonium sulphide as nickel sulphide (NiS), zinc sulphide (ZnS), and manganese sulphide (MnS).

If it is desired to test a solution for a certain metal, other metals that are in the groups preceding it will have to be precipitated first, unless it is known beforehand that they could not be present. If this precaution is not taken correct results can not be looked for. For instance, to test for copper in a silver plating bath the silver would have to be removed first, as otherwise the silver would be precipitated along with the copper as sulphide. In certain cases a reagent will react with only one or two metals, the non-interfering metals therefore would not have to be removed.

Before attempting to test a solution it should be tried with litmus paper to see if it is acid or alkaline, as this will help in deciding how to proceed to analyze it. For the present it would be best to get practice in separating the metals in each group, then after this the group separation can be tried.

For the first group weigh off about a gram of each of the following salts: silver nitrate, lead nitrate and mercurous nitrate; mix together, dissolve and dilute to 100 c.c. with water. Take out about 10 c.c. of the solution and proceed to separate as in the following outline.

An Outline for the Separation of the Groups Group 1

Take about 10 c.c. or more of the cold solution, depending upon the strength, in a small beaker and add dilute HCl in slight excess or until no more of a precipitate forms. Filter off the precipitate and wash once with cold water. (Save the filtrate to be tested for Group 2.) The precipitate may be AgCl , PbCl_2 , HgCl . The point of the filter in the funnel is broken and the precipitate washed through the stem into a beaker. Boil the precipitate with water for a minute or two and filter. All the lead chloride will be dissolved and can be tested by dividing the filtrate into two portions. To the first add dilute H_2SO_4 , a white precipitate of PbSO_4 will form, to the second portion add H_2S water, a black precipitate of PbS will come down. The insoluble residue in the funnel is washed once with hot water, then 10 to 15 c.c. of NH_4OH is poured over the residue; if it turns black it indicates mercury is present. To the ammoniacal filtrate add dilute HNO_3 until acid; a white precipitate of AgCl will form if silver is present.

Group 2

A solution containing the second group of metals can be made by taking about a gram of each of the following salts: mercuric chloride, copper sulphate and stannic chloride; dissolve in water with a little HCl and dilute to 100 c.c. Stannic chloride can be made from stannous chloride by oxidizing a gram of the stannous salt with 12 c.c. conc. HCl and 4 c.c. conc. HNO_3 . The solution is boiled until all of the excess acid is driven out. A lead salt is not taken, as a precipitate of lead chloride will form from the chlorides that are present. In preparing these solutions

*See previous issues of BRASS WORLD

care should be taken what kind of salts of the metals are mixed together. To have lead, mercury and copper in the same solution, the nitrates of these metals should be taken, as the chlorides or sulphates will form precipitates with lead. When a solution contains the different groups, the filtrate from the first group is saved and examined for the second group, then the filtrate from the second group is examined for the third, and lastly the filtrate from the third should be tested for the fourth group metals.

The filtrate from the first group, if acid, is made neutral by adding ammonia until it does not change litmus paper. Then add 2.5 c.c. conc. HCl and dilute to 100 c.c. with water. It has been found that this amount of acidity will prevent the other groups from precipitating with the second group metals, which might occur if the solution is not sufficiently acid. The solution is heated up to boiling, then pass in H_2S gas for about 10 min., let stand for a few minutes for the precipitate to settle, then filter it off on a folded filter paper; this kind of a filter affords quicker filtration. The precipitate is washed with hot water until all of the hydrogen sulphide is washed out. If hydrogen sulphide is present when sodium hydrate is added to dissolve out the tin it will combine with the sodium hydrate, forming sodium sulphide, which will dissolve the mercury sulphide. The majority of authorities recommend using yellow ammonium sulphide in place of sodium hydrate to dissolve the tin. The author has had less difficulty with the sodium hydrate than with the ammonium sulphide, and accordingly recommends its use. The precipitate may be PbS , HgS , CuS , SnS_2 . After washing with hot water it is washed once with a 5 per cent solution of ammonium nitrate which prevents the sulphide from becoming colloidal and running through the filter; this sometimes happens when the sodium hydrate solution is added. About 10 c.c. of a 5 per cent solution of NaOH is poured over the precipitates on the filter; after it has run through it is again poured over them. The sodium hydrate is finally washed out with the ammonium nitrate solution. The sodium hydrate solution is made slightly acid with dilute HCl, which will cause the tin sulphide to be precipitated as a yellow precipitate. The residue on the filter may be PbS , HgS , CuS . Pour over the residue to 10 c.c. dilute

HNO_3 (half water to half conc. HNO_3), letting it run through and again pouring back. The nitric acid will dissolve the PbS and CuS ; the HgS will remain undissolved as a black precipitate. It can be dissolved in aqua regia (1 c.c. conc. HNO_3 to 3 c.c. conc. HCl), then the excess acid is driven off by boiling; dilute with water and add stannous chloride; a white precipitate of mercurous chloride will form. The nitric acid solution containing the lead and copper is neutralized with NH_4OH and evaporated nearly to dryness. About 5 c.c. conc. H_2SO_4 is added and solution heated until white fumes appear; cool and dilute with 20 c.c. of water; a white precipitate will be $PbSO_4$. Filter, then to the filtrate add NH_4OH in excess. A blue color will indicate copper.

(To Be Continued)

The Mott Sand Blast Co. of New York and Chicago advise that they are receiving quite a number of orders for the Pneumatic Sand Blast Gun recently brought out by them. These machines are sold subject to trial, and the fact that they have not been returned indicates that this device is giving satisfaction wherever used. Apparently this gun fills a long-felt want for a practical, effective and low-priced sand blast outfit.

New and Fine Quarters

James H. Rhodes & Company, so long domiciled at 85 Front Street in New York, have removed the executive offices into a very commodious store at 162 William Street, where they have rearranged the premises to suit the needs of the business. The greater amount of room gained by the move was much needed; moreover they are now at home in a "chemical" neighborhood, as the chemicals trade is scattered all about the nearby streets. Mr. C. G. Griffiths, Jr., assistant secretary for the corporation, who keeps statistical tabs on the increase of business, has a most gratifying score of not-yet-filled orders, due to pressure on the factory already.

The June issue of *Graphite*, the sprightly little magazine issued in the interest of the J. Dixon Crucible Co., is of real value to those whose use of crucibles makes it important to know all the current thought and practice on the subject. The articles cover much ground. We believe the *Graphite* is mailed upon request.

Brass Casting in Permanent Molds

A paper presented by the secretary of the London branch of the British Foundrymen's Association to the members of his association at a recent meeting discussed the casting of brass in chill molds, and while the speaker was evidently unaware of the latest American developments in this line, his remarks were very interesting and are in part as follows: "Die casting of non-ferrous alloys of low melting points has long been familiar to foundrymen. The alloys so cast usually consist of tin, lead and antimony in varying proportions, also alloys with aluminum and alloys of zinc with from 5 to 75 per cent. of other metals, including copper. As a rule, however, the content of copper in die-cast metals does not exceed 10 per cent., though it is present up to 20 per cent. in a few mixtures. Alloys of copper are difficult to cast when this metal is present in excess of 10 per cent., owing to their comparatively high melting point. When it is recalled that iron is regularly cast in permanent molds there seems no reason why high copper alloys should not be also so cast. One reason is that copper alloys are not suitable for the usual die-casting apparatus on account of the fact that the dies are made of steel, engraved to give a fine finish to the casting without further treatment. Steel, as is known, does not stand well against the effects of the continued heating to which the dies are subjected, but cracks and disintegrates.

Accordingly steel makers prefer cast iron for ingot molds, as these are found to have a much longer life than steel molds. Steel ingots, of course, subject the molds to a much higher and prolonged heat than do non-ferrous alloys, but the latter affect the molds in the same way though in a lesser degree. As steel is not satisfactory for high temperature permanent molds, cast iron has to be used, and has given satisfactory service in the form of molds for casting iron. The first essential is a low silicon iron for the mold, to avoid the defect of growth through oxidation of the silicon and carbon under repeated heating. The mold should be made as cleanly as possible and designed so that the casting can leave it freely. An important feature in designing permanent molds is to prevent the shrinkage of the metal making cracks or weak places

in the casting. When dry sand cores are used in places where the castings cannot be cored with a die they should be of a light, hard nature adapted to crush and disintegrate as soon as the metal has just solidified. The successful prevention of shrinkage troubles depends on ejecting the castings from the molds at the right moment during cooling. This is more easy in the case of iron than with the non-ferrous metals as in the solidification of iron there is a distinct period of arrest of contraction due to the separation of the various constituents, which allows the casting to be turned out and any solid cores removed before the final contraction comes on. The arrests, in the case of non-ferrous alloys, are unfortunately not so long or so pronounced as in the case of iron unless the alloy contains a considerable amount of antimony; they are in fact rather retardations than arrests, therefore it is more difficult to take advantage of them; they do not take the form of actual expansions as in the case of the iron-carbon alloys. Large cores, however, may often be made of cast iron, constructed with a center that may be withdrawn directly the casting is set to allow the core to collapse.

The early removal of the casting from the mold has the advantage that the mold is not called upon to conduct away all of the heat from the casting, so that it does not become as hot as might be expected. Directly the metal enters the mold the surface of the casting is slightly chilled and commences to set rapidly, and with the pressure of a high head and heavy riser a dense, strong metal is obtained. To prevent the metal biting into the face of the mold and cores a dressing of plumbago should be applied and should be rubbed in and polished. If this is done with the first few castings the mold works much better and can be used several times without further dressing. The mold also works better when well warmed, after a few castings have been poured. In place of the plumbago various oils have been tried as a dressing; these do not seem to work very well owing to the gas generated. A far better effect is obtained by swabbing with crude petroleum or kerosene while the mold is hot; such a dressing rapidly volatilizes but leaves sufficient carbon deposit on the face of the mold to give a good skin to the casting which prevents the molten metal from biting into the mold. The use of burning rosin for smoking the molds is

practiced in the case of copper when cast in permanent molds.

Another trouble frequently encountered is the formation of blowholes and similar defects, apparently caused by gases forcing themselves through the metal. It is found in die casting that the position of the gate or head has a material influence in preventing such defects. It is impossible to lay down any rule, the matter being best settled by experience and experiment. But it is obvious that it is necessary to gate the mold at a point which will allow the air to be driven out through the joints and vents instead of trapping it. The nature of the dressing used on the mold is very important because if it produces gas some of the latter will inevitably be forced through the molten metal and be trapped. The air in the mold is a far less serious matter, for after all allowance for its expansion in the mold when heated has been made it is still highly compressible and easily forced out of the joints by the pressure of the oncoming metal. When, however, an oil commences to generate gas after the metal has flowed over it the case is very different, and the gases have to escape through the metal instead of before it.

The ordinary die casting machine, of course, largely relies on the pressure exerted by the apparatus to eliminate blowholes and similar defects. The metal also is cast directly onto the face of the die, no dressing being used. With simple permanent molds much the same effect is obtained by suitably arranging the gate and giving a sufficient height of head. The size of the gate must be governed chiefly by the nature of the casting and the character of the alloy that is used. Some metals require small spray gates and others large easy gates which prevent churning of the metal. The height of head which takes the form of a riser, if a deep drop in pouring is to be avoided, governs the pressure exerted on the mold. It must be born in mind that the diameter of the head is of little consequence; the pressure is not by reason of the deadweight of the metal above, but is strictly hydraulic pressure; hence the importance of height. The size of the head should preferably be slightly greater than the section of the casting to which it is attached in order to solidify after the casting, but there is no advantage in pressure gained by a big, low head

or riser over that obtained with a gate or sprue of smaller diameter."

In the discussion that followed one member, referring to the dressing of molds, stated that he was using linseed oil and plumbago with success. Regarding the subject of cores for permanent molds, another member mentioned that he used a mixture of three parts loam and one part of silica sand.—Abstracted from *Foundry Trade Journal*, London, Eng.

Russians Desire to Sell Platinum in United States

According to information from Petrograd that is contained in a commerce report, a meeting of the Russian Export Chamber was held, at which a report was presented on the work of the newly-organized bureau for the gold and platinum industries.

Some time ago an order was issued forbidding the exportation of raw platinum in quantities valued above \$257.50 in order that domestic refineries of the metal might be encouraged. No refinery has been opened in Russia, and the producers of platinum now have the metal on their hands and are unable to sell it. They have requested the bureau to find out whether or not sales of platinum might be organized in the United States.

In case of an affirmative answer, the producers will ask for a modification of the embargo.

Copper for Shells

The establishment of a plant for copper refining in Canada will likely take place, following a conference recently held between the Minister of Militia and others. It is intended to have every part of the shells which Canada is supplying made in Canada, and as far as possible of Canadian products. The smelting of copper in Canada is now considered feasible, says *Canadian Foundryman*, and the plant will probably be located in New Ontario. Canada is now turning out 30,000 shells a day, high explosive and as shrapnel. A very large amount of Canadian lead has been used in the manufacture of munitions, the lead mines having contributed 50,000 tons of lead shipped to England since the outbreak of the war.

Alloys of Copper and Tin

By J. L. HAUGHTON.*

From the results obtained from the micrographic examination of the annealed specimens and from the heating curves, the diagram shown in Fig. 1 is constructed. It remains to discuss the difference between this diagram and those of former investigators.

Neither Shepherd and Blough nor Hoyt have published any photomicrographs, therefore it is impossible to weigh the evi-

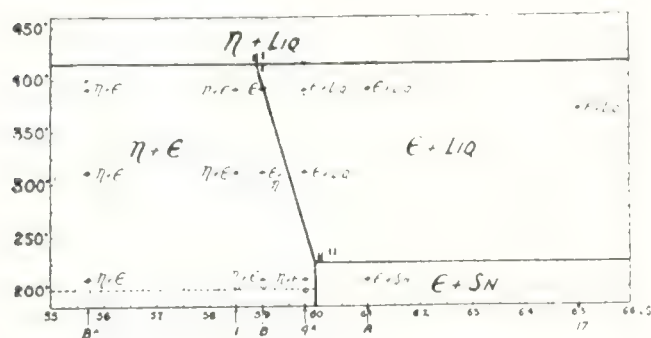


Fig 1—Part of the Copper-Tin Equilibrium Diagram (Haughton)

dence for their diagrams. A glance at the micrographs in Giolitti and Tavanti's paper shows that the alloys are very far removed from equilibrium. Indeed, it would appear that they made no effort at all to anneal their specimens, but merely relied on cooling slowly (from 800 deg. C. to 200 deg. C. in about 160 min.), which, of course, is quite inadequate for these alloys. Furthermore, they state that all specimens between 43 per cent tin and 91 per cent tin consist of three constituents in addition to the eutectic, a state of affairs which is absolutely impossible in binary alloys even approaching equilibrium.

There remains therefore Heycock and Neville's diagram. The principal points of difference between their diagram and the author's are:

1. They give the composition of the first formed as 61.1 per cent tin, whereas the present diagram puts it at 59 per cent tin.
2. They show the line H'H" as meeting the eutectic line at 65 per cent tin, whereas the present diagram places the point H" at a composition of 60 per cent tin.
3. The temperature at which ϵ forms is given by them as 400 deg. C., and in the present diagram as 415 deg. C.

*Abstract from a paper by the author on The Constitution of the Alloys of Copper with Tin.

Considering first the position of the point H'. Heycock and Neville fixed on this by two methods, (1) by isolating the ϵ body of chemical means and analyzing it. This is a notoriously difficult and unreliable method, though due weight must be given to evidence obtained in this way when it agrees with that obtained otherwise, as it does in this case. The values obtained varied from 60.4 per cent tin to 61.4 per cent tin, the mean being 61.1 per cent tin. (2) By microscopical examination of annealed specimens. They say, "We have succeeded in transforming all the alloys from Sn 45 (60.4 per cent tin) to Sn 87 (92 per cent tin) into complexes of H" (i.e., β) "and tin free from π , and although it will not be quite so evident from the photographs, we think we have eliminated all the eutectic from the alloys between tin 25 (38 per cent tin) and Sn 45 (60.4 per cent tin)."

The whole evidence rests on one photograph, that of Sn 45, as all the other photographs are of alloys lying in regions where the two diagrams are in accord. Heycock and Neville say about this one photograph: "All the π , except mere traces, could be removed from Sn 45, but although large portions of the section were compact H, yet there were large gaps in the H. These gaps appear to be cavities in the ingot, and



Fig. 2—61.9 per cent. Tin. 74 hours at 390° C., followed by slow cooling. ϵ (light) + eutectic (dark)

not spaces full of eutectic. These gaps are numerous in all the alloys, such as Sn 45 to Sn 40 (55.4 per cent tin) when they have been boiled for a long time in mercury. We think it probable that they are due to a contraction accompanying the re-

action in which the H is formed from the mixture of π and liquid."

Cavities

The author's contention on this point is that the gaps may quite possibly be "cavities in the ingot, and not spaces full of eutectic," but that if so, they are *cavities from which eutectic has fallen out during polishing*, or from which it has receded during quenching. If this photograph

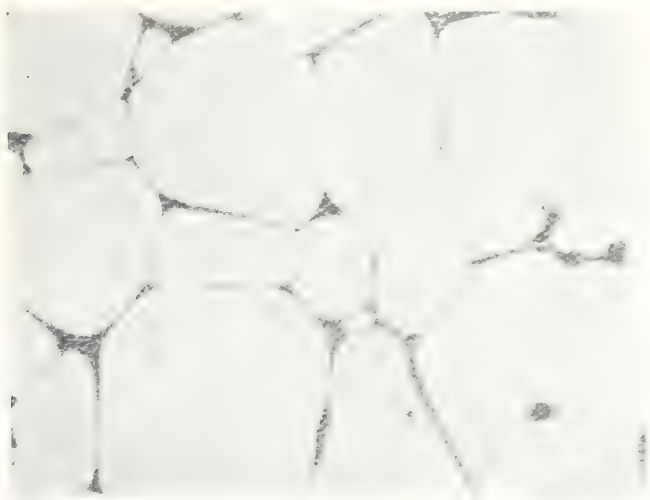


Fig. 3—61.0 per cent. Tin. 74 hours at 390° C. ϵ (white) + chilled liquid eutectic (grey) + cavities from which latter has fallen out (black)

(No. 95 in Heycock and Neville's paper) be compared with Fig. 2 the great similarity between the two will be obvious when the different magnification is taken into account. Fig. 2 represents an alloy of very similar composition to Heycock and Neville's Sn 45—i.e., 61 per cent tin—which has been annealed for seventy-four hours at 390 deg. C., and then slowly cooled. In this photograph it is obvious that the dark spaces are eutectic areas and not cavities. Compare also Fig. 3, where the dark spaces can be seen to be cavities in some places and eutectic in others, and Fig. 4, which shows one under high magnification.

Furthermore, the author has always found that the action of the etching reagent on the ϵ constituent is a very delicate test for the presence of eutectic. Should this be present to any appreciable extent, the ϵ remains perfectly white. When, however, the eutectic reaches very small proportions the ϵ is really attacked with quite weak Fe_2Cl_6 . Judged by this test, Heycock and Neville's photograph contains some eutectic.

In view of these facts, the author feels justified in moving the point H' from 61.1 per cent to 59 per cent.

2. *The Point H''*.—As to this point, Heycock and Neville say: "There is very little justification . . . for the slope we have given to the branch H'H" of the solidus, and we have therefore drawn it as a dotted line to indicate the uncertainty. We think a further examination of such alloys as Sn 47, after a prolonged heating at 250 deg. C., may settle the position of H''. At present the only argument for placing H'' at Sn 50 is to be found in the numerical value of the depression of the freezing point of tin by small additions of copper—that is, from the slope of the branch I K of the liquidus. This appears to prove that, whatever the molecule in solution in the liquid tin, it can contain only one atom of copper."

This being the case, it is hardly surprising to find that the line needs altering. Indeed, the surprising thing is that Heycock and Neville placed it so near to the true position. The reasons for its present position are:

A. Microscopic evidence shows that at 390 deg. C. 59 per cent tin is pure or almost pure ϵ .

B. The same evidence shows that at 315 deg. C. 59 per cent tin consists of $\pi + \epsilon$, and



Fig. 4—59.8 per cent. Tin. 48 hours at 390° C. ϵ + chilled liquid eutectic. (1,200 dia.)

59.8 per cent tin of $\epsilon + \pi$ eutectic—that is, pure ϵ must lie between these two values.

B₁. As a confirmation of this, 58.5 per cent tin contains very much more π at 315 deg. C. than at 390 deg. C.

C. In the same way it is shown that at 210 deg. C. 59.8 per cent tin consists of

$\pi + \epsilon$, so that pure ϵ contains more than 59.8 per cent tin, and less than 61.0 per cent tin at 210 deg. C.

C₁. Confirming this is the pyrometric evidence that 59.8 per cent tin contains no eutectic at 225 deg. C.

C₂. Further confirmation is obtained from the observation that 59.0 per cent tin contains more π at 210 deg. C. than it does at 315 deg. C.

This evidence would appear to justify the position given in Fig. 1 to the line H'H".

3. *The Temperature of Formation of ϵ .*—As has been already pointed out by Shepherd and Blough, the fact of surfusion renders unreliable the position of lines obtained by cooling curves. It will be observed that the mean temperature obtained, in the present research, by means of cooling curves, for the ϵ reaction is 401 deg. C., while the heating curves give it at 415 deg. C. As Heycock and Neville used cooling curves to obtain their line, it may be expected to be somewhat low.

Following Heycock and Neville, the line of pure ϵ is drawn vertically below the eutectic line. There is no experimental evidence in support of this, and the point needs further investigation.

A Strong Testimonial on Silver Solders

The strongest kinds of testimonials are usually those received from parties who for business reasons do not care to have their names published. In this connection the advertisement of the J. M. Ney Co. of Hartford, Conn., manufacturers of silver solders is rather unique. This ad refers to an actual experience in which solders purchased from the Ney Co. were used, but for obvious reasons, this firm is not at liberty to mention the customer's name.

The actual circumstances are as follows:

A friend asked the junior partner in one of the oldest manufacturing concerns in Manhattan about his firm's experience with solders, and whose brand they are using. Said the junior, "We know about solders all right. We ought to, as we're the oldest concern in this business and were first to use solders. Had lots of trouble and about ten years ago we began dealing with another concern. We did not like their solders either. They

were not satisfactory, but as they were better than what we had been using, we stuck to them, but always hoped to find something good enough for our needs. One day, another concern with which we are very friendly, although competitors, told us where they bought their solders. Said they had "never found their equals." So we ordered some. I tell you we felt that we had found a gold mine after we began using these. Since then we have stuck to that brand exclusively, because we know it's the best in the world. But you'll have to excuse me for refusing to tell you the maker's name. We want to keep that to ourselves."

Imports and Exports of Copper

The following tables show in detail the imports and exports of copper at the customs districts of New York, Massachusetts, Philadelphia, Maryland, Virginia, Galveston, New Orleans, San Francisco, Washington and Michigan during the week ended June 12, 1915:

Countries	IMPORTS			
	Ore, matte, and regulus (copper contents)		Pigs, ingots, bars, plates, and old, etc.	
	Pounds		Pounds	
Canada ..	173,962	\$19,162	346,200	\$59,994
Cuba	560,000	48,902		
Peru ....	.....	.....	1,851,931	204,655
Japan ...	.....	.....	320,248	49,501
Total ..	733,962	\$68,064	2,518,379	\$314,150

Countries	DOMESTIC EXPORTS	
	Pigs, ingots, bars, plates, rods, scrap, and old	
	Pounds	
France	7,121,938	\$1,328,234
Iceland	29,088	3,600
Italy	743,187	134,280
England	2,809,347	536,065
Scotland	112,008	20,161
Canada	2,594	568
Honduras	27	8
Panama	11,171	1,287
Newfoundland	1,868	295
Cuba	2,990	598
Ecuador	660	125
Peru	2,977	525
Uruguay	2,208	417
Russia in Asia	224,174	42,593
Total	11,064,237	\$2,068,756

The unprecedented demand for nickel, largely for the manufacture of munitions of war for the allies, has necessitated a further increase in the output of the leading producers, it is reported.

Recent Progress in Cleaning Metal Surfaces

By John Nelson*

When I started in the plating game a little over 20 years ago the standard method in use for cleaning the articles to be plated was to immerse them in a boiling solution of caustic potash, caustic soda or combination of both, with carbonate of soda usually added and known as lye.

After the articles were immersed in this boiling solution for some time they were either dipped in acid or cyanide solution. Articles of steel and iron were scrubbed with pumice stone, and those of brass were scrubbed with lime or whiting. This method was rather expensive, and since competition has become keener and the cost of labor higher, it has become necessary to reduce costs.

The first efforts in this direction were made without due consultation with the plater, and, as is usually the case when any one not thoroughly familiar with the subject handles it, the wrong thing was done. In this instance skilled labor with high efficiency was replaced with cheaper unskilled labor. Defective work soon made the cost higher than before. Efforts were also made to obtain cheaper prices for the caustic alkalies, acids, etc. The result was that articles of inferior test were of necessity supplied.

In the meanwhile newer methods were being introduced. One of these methods was cleaning by electricity, but at the present time this method, although very economical compared with previous methods, is replaced by a still more efficient method, namely, immersion in a boiling solution of a double salt. It works on an entirely different principle from the caustic alkalies or allied salts and it is sold under the trade name of Carlsruhe cleanser.

We are all aware of the fact that when greasy or oily articles are boiled in caustic alkalies they unite to form a soap. In consequence when they are taken from the boiling solution they have a film of soap on the surface. It is very difficult to eliminate this, especially on large flat surfaces. There is the further disadvantage that mineral oils are not always removed, and they have to be scrubbed off or otherwise removed.

Carlsruhe, however, eliminates all kinds of oils and greases and forms with them an insoluble compound which is thrown out of the solution, leaving the surface of the metal chemically clean and free from the soapy mixture which is left in the microscopic hair lines and irregularities on the surface by the customary processes of cleaning.

Carlsruhe cleanser is a chemical product, the manufacture of which is covered throughout the civilized world by patents. The combination of sodium, aluminum, silicon and oxygen effected by this special process yields a double salt which is a most efficacious cleaner, possessing several very important advantages in addition to its novel method of cleaning.

It comes in granular form, is cream colored in appearance and is readily soluble in water; it will not absorb moisture, however, no matter how long it is exposed to the damp air of the plating room, being very much unlike the caustic alkalies or lye in this respect.

We all know how readily copper or its alloys are tarnished in a boiling solution of the alkalies. With Carlsruhe, however, this is absolutely eliminated, irrespective of the length of time the work is left in the cleaning bath.

Many of us have suffered at one time or another from caustic alkali burns, and we have often wished that we could get away from using anything so dangerous. Carlsruhe, unlike the common alkalies, is neither caustic nor corrosive. You can wash your hands in it with impunity. There will be no dangerous after effects. Moreover, the poisonous and irritating fumes which sometimes arise from boiling solutions are lacking with Carlsruhe.

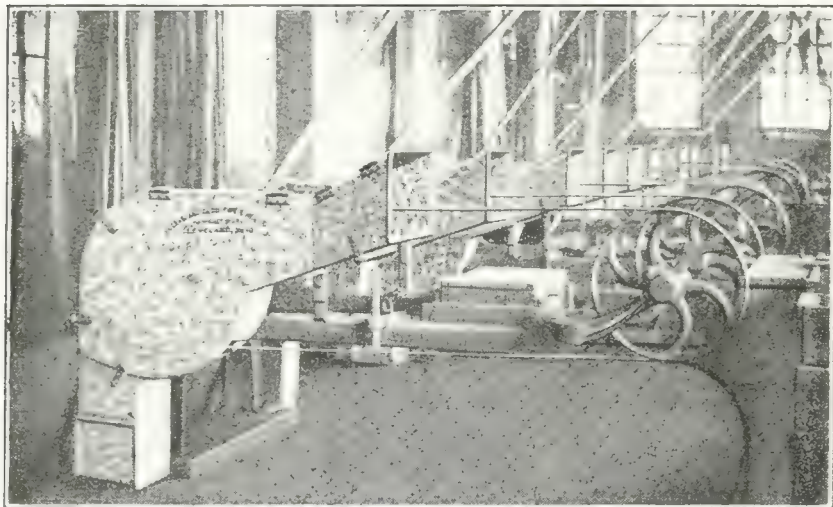
I do not wish to go on record as stating that cleaning by electricity and scrubbing belong entirely to the past, as in some instances these methods are the best, but in the great majority of cases the work can be handled to better advantage by simply boiling in a Carlsruhe solution.

It is possible to use Carlsruhe cleanser to very good advantage in connection with the electric current, inasmuch as it liberates a great amount of gas for the current consumed and, as we know, it is this liberation of gas on the surface of the metal which throws off the grease and oils. It is rather a mechanical than chemical effect.

*Expert with James H. Rhodes & Company.

An Improved Dust-Collecting System

An efficient dust collecting system is now considered a very important and necessary part of the equipment of every grinding and polishing department. Such a system not only satisfies the requirements of State laws, but gives a lower insurance rate, and by improving the working conditions of the employees, it actually increases the output to a very appreciable extent. In the "safety first" crusade, which is now sweeping over the country, the use of protecting hoods for polishing lathes, grinders, etc., are an important feature.



The Cleveland Blow Pipe & Mfg. Co., 2096 W. Third Street, Cleveland, Ohio, have achieved a fine reputation as manufacturers of a very complete line of dust collecting systems. As a result of many years specializing in this line of work they have developed and perfected a line of equipment of the highest efficiency which is standard in the trade. Experience shows that this line will meet practically all the requirements in any given case, although changes may be made to meet any special conditions.

A variety of types of hoods are furnished, including adjustable, standard and vacuum hoods, which are used on buffing, polishing, emery and grinding wheels to collect dust and refuse from the wheels.

These hoods are made from heavy gage galvanized steel with the seams closely riveted and the edges reinforced with 1 in. x 1/8-in. band iron, blast gate fastened to pipe collar, thus saving power when hood is not in use.

The top portion of hood, covering upper part of wheel is hinged at back, together with hinged door on lower portion of hood,

hence wheel removal from spindle is easily effected. The adjustable features are rigidly held in any position by thumb-screws.

In a catalog recently issued by the Cleveland Blow Pipe & Mfg. Co., a great variety of device in this line are fully illustrated and described. Those interested should write for a copy.

Copper Deposits of the Ketchikan District, Alaska

The copper deposits of the Ketchikan district, southeastern Alaska, were known to the Russians before the acquisition of the territory, and there was a crude attempt to develop them as early as 1880. It was not until 1901 that systematic mining was begun and not until 1905 that a large annual output was made. Up to the close of 1913 the mines of the district had produced about 22,640,000 lb., valued at \$3,760,000, and \$500,000 worth of gold and silver.

Most of the mines lie at or near tidewater. There is an abundance of timber, and the relief favors the undecutting of the ore bodies. While there are as yet only a few producing mines, there are many undeveloped copper prospects which give promise of containing commercial ore bodies. Many of the copper deposits show an irregularity of occurrence that is unfavorable to cheap exploitation, but otherwise the conditions are favorable to low mining costs.

In view of the important mining development, a detailed study was entered upon by C. W. Wright. The results of this work, which covered the most productive part of the field, have just been made public by the U. S. Geological Survey in a report entitled "Geology and Ore Deposits of Copper Mountain and Kasaan Peninsula, Alaska." This report is accompanied by detailed geologic and topographic maps and includes descriptions of the copper deposits and their geologic occurrence. It deals primarily with the copper ores, which are at present the most important mineral deposits of the two areas examined.

"Keep your eye on the BRASS WORLD."

TRADE OPPORTUNITIES

The names and addresses of subscribers who have sent in any of the following inquiries will be furnished to any of our advertisers on application. In writing it is only necessary to give the serial number of the inquiry.

Inquiry No. 12—Hellberger Electric Transformer Crucible Furnace

In an old issue of the BRASS WORLD you published an article entitled "The Hellberger Electric Transformer Crucible Furnace," concerning an electric furnace made in Germany. Can you furnish us with the name and address of any company in this country who handles this or a similar furnace?

Inquiry No. 13—Parts for Lighting Fixtures

Would you please give me the names of a few firms who manufacture parts for lighting fixtures such as castings, spinings, turnings, etc.?

I notice so many parts on fixtures of different manufacturers which are exactly alike, and I thought that there must be some firms who sell these parts to be assembled by any manufacturer in any combination they see fit.

Inquiry No. 14—Mellen Rod Machines

Will you kindly tell me who is building the Mellen Rod Machines, a brief description of which has been located in the October issue of the Brass World. Please also express your opinion about this machine, if it could work successfully.

Inquiry No. 15—Bronze and Phosphor Bronze Wires

Will you be good enough to advise us who manufactures bronze and phosphor bronze wires?

Inquiry No. 16—Broken Crucibles

Can you give us any information with reference to reliable purchasers of broken crucibles?

We have about a carload of this material on hand and would like to dispose of same to the best possible advantage.

Inquiry No. 17—Belgian Trade

Willy Lamot of Belgium, present address Shardhigs, Halstead (Essex), England, wishes to advise American trade that a combination of Belgian merchants (at present expatriates) have completed an organization to introduce in Belgium, immediately after a conclusion of peace, American goods. These Belgian merchants have the knowledge of the business, the capital and the plans backed by proper guarantee, to press the trade. At present address Mr. Lamot as above, and in view of insecure mail deliveries, follow your original letter with a duplicate to same effect and tenor, in a fortnight thereafter.

Inquiry No. 18—Plating Tanks

We think of using wood plating tanks that need no lining. Before making a decision we wish to examine the claims of all makers who supply such articles.

Inquiry No. 19—Nickel Electro Plating Powders

Can you advise us where we can procure nickel electro plating powders?

No More "Dear Sir." Dreadful!

Ambassador Gerard writes that certain German firms attach slips to their letters to aid in a movement to suppress unnecessary terms of politeness in business correspondence, such as the introductory phrases "Sir," "Gentlemen," and the concluding phrases "Yours, truly," "With the assurance of, etc." The slip, translated, reads: "Following the example of other firms, I also omit from my business letters the unnecessary terms of politeness, as well as assurances of self-evident esteem. I re-

quest that you reciprocate in your correspondence with me."

The elimination of salutations and closing phrases has also been adopted by some firms in the United States.

We quote E. L. Stiles, Winter Hill, Mass.: "I have been a subscriber to BRASS WORLD ever since it was first started. In fact have nine years' numbers bound, and find that many times I can refer to this library for something to help me out."

CLASSIFIED ADVERTISEMENTS

Advertisements for Help Wanted or Situations Wanted published free of charge to subscribers. Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars. If in display type—two dollars per inch, each insertion.

Help Wanted

ENAMELING EXPERT—A man thoroughly familiar with sanitary baking enamels and with methods of applying them by dip or spray process to articles after they are formed. In answering state age, whether married or single, least salary expected, and references. Address "B C" care of Brass World, Edison Bldg., New York.

WANTED—Foreman for brass foundry, manufacturing a line of small work similar to builders' hardware, padlocks, etc. Must be a hustler, progressive and up to date and be able to furnish A-1 references. In replying give a full and detailed account of past experience, places previously employed and length of service, age, nationality and wages expected. Address "E. M. O.," care of Brass World, Edison Bldg., New York.

SALESMAN wanted by concern making a superior line of supplies for metal finishers. Must be acquainted with the trade. Commission basis only. Liberal inducements to the right man. Address Box 3, BRASS WORLD, Edison Bldg., New York.

FOREMAN PLATER—Competent man who can take charge of room. Must be A1 on both flat and Britannia Metal Hollow-Ware. Give references and salary required with application. Address Box 8, BRASS WORLD, Edison Bldg., New York.

Situations Wanted

EXPERT PLATER—Nickel, copper, brass and zinc plating. Seventeen years' experience. Assure best work, and at a great saving. Address Box 1, BRASS WORLD, Edison Bldg., New York.

FOREMAN ELECTRO PLATER—Well known in the trade, is desirous of connecting with a reliable concern. Have had a

broad experience on a large variety of work, in gold, silver, nickel, black nickel, copper, brass, bronze and zinc plating, on silverware, bicycles, stoves, saddlery hardware, typewriters, builders' hardware and all kinds of brass goods. Thoroughly understand all solutions and the production of all finishes, both standard and special. Capable of handling large departments, including polishing, buffing, burnishing, lacquering and etching. Sand tumbling, barrel polishing and ball burnishing. Barrel plating of all kinds. Modern methods for economical production. Address Box 2, care BRASS WORLD, Edison Bldg., New York.

PLATER—14 years' experience. Gold, silver, nickel, copper, brass, bronzes, oxidizing, etc.; can fit up plant; make solutions; seeks steady position in vicinity of New York. For further information address Box 5, care BRASS WORLD, Edison Bldg., New York.

FOREMAN PLATER—Experienced in various lines; bright copper, brass and nickel solution a specialty; wide experience on mechanical plating machines. A1 references. Will accept position anywhere in U. S. Address, Box 7, Brass World, Edison Building, New York.

POLISHER, BUFFER AND PLATER—First class as all three. Want to make change. Prefer Chicago, New York or its suburbs. Address "CAPABLE," care Brass World, Edison Bldg., New York.

PLATER, POLISHER and BUFFER—Wide experience, desires position where executive ability is required. Have made and used all known solutions on any line of work. Installing plants, and introducing efficient systems for day or piece work a specialty. Address "Experience," care Brass World, Edison Bldg., New York.

ELECTROCHEMIST—Graduate Toronto University, varied experience in analysis, research, manufacturing and factory costs department. Employed for past year by one of the largest silverware factories in Canada. Especially familiar with non-ferrous alloys and electro-plating. Have a process by which flatware can be plated and sectional plated, both in one operation. Address "ELECTRO," care Brass World, Edison Bldg., New York.

FOREMAN PLATER—Nickel-plating, polishing and buffing departments. At present in charge of these departments, but wish to make change. Twenty-five years' experience. Can furnish best references; sober and reliable. Address Box 6, care Brass World, Edison Bldg., New York.

FOREMAN PLATER—18 years' experience as practical, all-around man. Can make and take care of all solutions, also make all dips, stains, and bronze finishes of any shade. Toning of metals to match sample of any color. Experienced on lighting fixtures, lamps, trunk hardware, hollow ware and architectural bronze work. Position in Greater New York preferred. Address "PRACTICAL PLATER," care Brass World, Edison Bldg., New York.

POLISHING—This one thing I know. Have made many labor-saving devices, reducing cost over one-half, at same time doing better work. Are used in present position. Twenty years spent in studying and producing results. High references. Address "POLISHER," care Brass World, Edison Bldg., New York.

FOREMAN PLATER—Experienced man can take charge of polishing and buffing; has good reference from last place, where I had charge of the plating department in fancy brass goods. Experienced on such goods as chafing dishes, percolators and electro tin, also silver plating. Address Box 4, care Brass World, Edison Bldg., New York.

For Sale

FOR SALE.—Plating dynamo, Form N, No. 3, Hanson & Van Winkle, complete with rheostat. In first-class condition.

Used but a short time. Write Buffalo Scale Co., Inc., Niagara and Ferry Streets, Buffalo, N. Y.

Zinc in Japan

The zinc industry in Japan is still in its infancy, there being only two factories—the Amagasaki Zinc Factory and the Mitsui Bussan Kaisha Zinc Refinery. On account of the outbreak of the war the imports of zinc into Japan from Germany and Belgium have been totally suspended. Naturally, the price of the metal, which ruled at \$120 gold per ton before the war, has risen steadily, and now rules at over \$200 per ton.

In Siberia there are large zinc mines, the output of which has hitherto been forwarded to Germany and Belgium. With the opening of hostilities the supply of zinc ore to Europe became impossible and prices fell considerably. Taking advantage of this, the Mitsui Bussan Kaisha entered into an arrangement with owners of zinc mines for supplies.

25/75 Manganese Aluminum

This alloy is made from 98 per cent. pure manganese metal, carbon free, and new ingot aluminum. It is therefore free from iron and carbon. A small addition of manganese in the form of this alloy should greatly strengthen aluminum castings, close the grain and reduce shrinkage. There seems to be quite a field for this alloy and good results are already being reported by the Goldschmidt Thermit Company of New York, as also the nickel copper which is described.

50/50 Nickel Copper

This alloy should come in very handy in mixes where a small percentage of nickel is required, as the alloy dissolves very readily and at a very much lower temperature than pure nickel, thereby avoiding the high heat necessary for melting pure nickel. This 50/50 nickel copper will be found of great economical advantage in all so-called red-metal alloys where nickel is introduced to promote fineness of grain and increase of tensile strength and also to prevent the segregation of lead in a plastic lead or bearing alloy. The addition of about 1 to 3 per cent. of this alloy can be used to great advantage when holding up lead in high lead mixtures running about 30 to 40 per cent. lead.

Current Metal and Supply Prices

It is impossible in giving a list of current prices of metals and chemicals to do more than to furnish quotations which are approximately correct at the time of going to press. The prices of many of the items included below are influenced by war and other conditions which make them unstable at the present time.

CHEMICALS

Acetone, pure 98-99 per cent.....	\$0.30 lb.	Lead, red (pure).....	.15 lb.
Acid, acetic, pure 30 per cent.....	.10 lb.	Lead, yellow oxide (litharge)	.15 lb.
Acid, arsenious (white arsenic).....	.10 lb.	Liver of sulphur, see Potassium sulphide.	
Acid, boracic (boric), pure.....	.15 lb.	Manganese, metallic, pure and carbon free,	
Acid, hydrochloric, see Acid, muriatic.		1.00 lb.	
Acid, hydrofluoric, 30 per cent... .03 @	.03 1/2 lb.	Magnesium, metallic	3.00 lb.
Acid, hydrofluoric, 48 per cent... .06 @	.06 1/2 lb.	Mercury bichloride (corrosive sublimate),	
Acid, muriatic, 20 deg.....	.05 lb.	crystals	1.27 lb.
Acid, muriatic, c. p., 20 deg.....	.12 lb.	Nickel and ammonium sulphate (double	
Acid, nitric, 38 deg.....	.06 1/4 @ .06 5/8 lb.	salts)	.08 lb.
Acid, nitric, 40 deg.....	.06 1/2 @ .06 5/8 lb.	Nickel carbonate, dry.....	.50 lb.
Acid, nitric, 42 deg.....	.07 7/8 @ .08 1/4 lb.	Nickel, metallic	.60 lb.
Acid, nitric, c. p.....	.14 lb.	Nickel sulphate (single salts).....	.20 lb.
Acid, sulphuric, 66 deg.....	.05 lb.	Nitre (saltpetre), see Potassium nitrate.	
Acid, sulphuric, c. p.....	.12 lb.	Oil of vitriol, see Acid, sulphuric.	
Alcohol, wood	.55 gal.	Paraffin, high viscosity.....	.22 @ .23 lb.
Alcohol, denatured	.55 gal.	Phosphorus	.35 @ 1.00 lb.
Alum, burnt and powdered technical.....	.15 lb.	Pitch	.05 lb.
Alum, commercial	.20 lb.	Plaster of Paris, dental	.05 lb.
Ammonium sulphate	3.37 1/2 @ 3.40 lb.	Potassium bichromate, c. p.....	.50 lb.
Aqua-Fortis, see Acid, nitric.		Potassium carbonate	.40 lb.
Ammonia water (aqua-ammonia), 20 deg.,	4 1/4 lb.	Potassium cyanide chloride mixture..	.25 @ 29 lb.
Ammonia water (aqua-ammonia), 26 deg.,	.06 1/4 lb.	Potassium iodide	3.15 @ 3.20 lb.
Ammonia water, c. p.....	.10 lb.	Potassium nitrate (nitre or saltpetre),	.17 @ — lb.
Ammonium carbonate, lump.....	.10 lb.	Potassium permanganate	.90 @ .95 lb.
Ammonium chloride (sal-ammoniac)....	.08 lb.	Potassium, red prussiate	1.30 lb.
Ammonium hydrosulphuret	.25 lb.	Potassium sulphide (liver of sulphur)...	.20 lb.
Ammonium sulphate	.07 lb.	Potassium sulphuret, see Potassium sulphide.	
Amyl acetate	3.00 gal.	Potassium sulphocyanide	.40 lb.
Antimony (fine powder).....	.25 @ .26 lb.	Pumice, ground	.05 lb.
Arsenic, metallic	.10 lb.	Rosin, yellow	.08 lb.
Arsenic, white (acid arsenious)	.10 lb.	Sal-ammoniac, see Ammonium chloride.	
Benzol, pure	.90 @ 1.00 gal.	Sal-soda, see Sodium carbonate.	
Bismuth, metallic	2.50 @ 2.55 lb.	Silver chloride, dry.....	.65 oz.
Blue-vitriol	.08 lb.	Silver cyanide	.55 oz.
Borax, crystals or powdered	.12 lb.	Silver nitrate, crystals	.45 oz.
Borax glass	.30 lb.	Silver trisalyt	.24 oz.
Carbon bisulphide	.20 lb.	Soda-ash	.05 lb.
Calcium carbonate (precipitated chalk)..	.10 lb.	Sodium biborate, see Borax.	
Chrome-green, c. p.....	.26 @ .30 lb.	Sodium bisulphite	.06 lb.
Cobalt, metallic, pure and carbon free..	2.50 lb.	Sodium carbonate (sal-soda), crystals...	.02 lb.
Copper acetate (verdigris).....	.35 @ .40 lb.	Sodium hyposulphite ("hypo").....	.03 lb.
Copper carbonate, dry.....	.20 lb.	Sodium, metallic	1.00 lb.
Copper, sulphate (blue-stone).....	.08 lb.	Sodium nitrate	.05 lb.
Copper trisalyt	.30 lb.	Sodium phosphate (crystal)	.09 lb.
Copper cyanide	.45 lb.	Sodium silicate (water-glass)	.05 lb.
Corrosive sublimate, see Mercury bichloride.		Spelter, see Zinc.	
Cyanide, see Potassium cyanide.....	.30 lb.	Sugar of lead, see Lead acetate.	
Dextrin	.15 lb.	Sulphur (brimstone), in lump.....	.06 lb.
Emery flour	.05 lb.	Tin chloride	.13 lb.
Emery, F F & F F F.....	.03 lb.	Turpentine, spirits of	.55 gal.
Flint, powdered	25.00 ton	Verdigris, see Copper acetate.	
Fluorspar	30.00 ton	Water-glass, see Sodium silicate.	
Fusel-oil	3.35 gal.	Wax, beeswax, yellow	.30 @ .33 lb.
Gold chloride	11.75 oz.	Wax, carnauba	.45 @ .47 lb.
Gold trisalyt	10.00 oz.	Whiting (ground chalk)	.05 lb.
Iron perchloride (110 lb.).....	.20 lb.	Zinc, carbonate, dry	.25 lb.
Iron sulphate (copperas)	.05 lb.	Zinc, chloride	.10 lb.
Lead acetate (sugar of lead).....	.13 lb.	Zinc cyanide	.35 lb.
Lead, pig, trust price.....	.05 3/4 lb.	Zinc, sulphate	.05 lb.
		Zinc (spelter)	.22 lb.
		Zinc, trisalyt	.28 lb.

METALS

Aluminum, 99 per cent.....	32.00 to 33.00	Lead, outside	5.60 to 5.65
Antimony, Chinese and Japanese. 35.75	to 36.25	Nickel, nominal	50.00
Cadmium, nominal	1.25 to 1.70	Platinum, soft, nominal	40.00
Copper, electrolytic	19.62 1/2 to 19.87 1/2	Silver (official)	.47 3/4
Copper, casting	18.22 1/2 to 18.25	Spelter, prompt western.....	21.70 to 22.20
Lead, trust	5.75	Spelter, spot, nominal.....	21.75 to 29.25

All price lists on brass and copper products have been withdrawn.

The Brass World & Platers' Guide

Volume XI
Number 8



New York
August, 1915

A Monthly Journal Devoted to the Art of Refining, Alloying, Casting, Rolling Founding and Electroplating of All the Non-Ferrous Metals and their Alloys

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Zinc in a New Role

The continued high price and scarcity of zinc has upset all the traditions of the brass foundry trade. The Cinderella of the profession—yellow brass—has metaphorically speaking, married the prince who found the crystal slipper, having advanced from the position of the most humble, to that of the most aristocratic of the commonly used alloys.

Every one is familiar with the reasons for this phenomenal advance, and no one believes in its permanency, although one authority has gone on record with the statement that zinc is one of the metals the price of which is likely to be higher in the future than in the past, owing to the fact that the normal demand is increasing somewhat more rapidly than the ore supplies. This is, however, a debatable point, for on the other hand it is not now possible to conceive how far reaching will be the effect of the economy in the use of zinc which stern necessity is now imposing.

The probability is that in due course of time zinc will drop back in price to near its old level, and once again yellow brass will be specified as the material for non-ferrous cast parts where cheapness is the greatest desideratum. In the meantime, however, manufacturers of red and yellow brass castings are keenly alive to the desirability of decreasing their consumption of zinc during the prevalence of the present conditions.

For some classes of castings, as for instance the cheaper grades of plumber's goods, that are run in "red metal," the zinc content of the alloy can be materially lowered and replaced with lead: in one case where this was done a saving of over a cent per pound was the result, and the new alloy was just as good as the old for the purpose intended.

Lead, however, decreases ductility, and in castings where the latter quality is essential, the lead must be kept low, especially when zinc predominates in the mixture, therefore, it cannot be cheapened to any great extent by increasing the lead at the expense of the zinc, neither can much scrap be used unless its composition is known.

The only move that can be made is to increase both tin and lead and decrease the zinc, and viewed from the old standpoint, this appears impractical, as it would only

result in a still greater increase in the cost of the alloy, so that it would be better not to attempt any change.

But as before remarked the old traditions have been swept away, the status of the metals has so changed that lead is the only low priced metal available for the production of "cheap" alloys. To those who have never used such alloys, it is surprising what ductile and otherwise excellent metals can be formulated with lead in the leading role in the alloy. A mixture containing 17 per cent of white metals, 10 per cent of which is lead, possesses such ductility that a test bar 1½ in. wide, 8 in. long and ¼ in. thick can be bent and hammered double without the sign of a fracture. This alloy was designed especially to replace the well known red brass containing 10 per cent zinc, 3 per cent lead and 2 per cent tin, an excellent, and under the old order of things, low priced alloy. The leaded alloy saved nearly a cent per pound and answered the same purpose as the alloy just given. It shows that a little manipulation of the component parts of high zinc alloys can be profitably indulged in just at the present time.

Phosphorizing Metals

Phosphorus is one of the best, and at the present time the most easily applied of deoxidizers for copper-tin alloys.

It is the most easily applied because it can be readily obtained in the form of a solution of phosphorus in copper, known as "phosphor-copper," in which form, in large brass foundries, it is bought by the ton, and is used in quantities varying from one-third of a pound to seven pounds and upward per hundred pounds of bronze, thus adding with certainty a predetermined amount of phosphorus to the alloy treated, which is deoxidized or hardened as required.

A solution of phosphorus in tin was formerly used very extensively as the medium for carrying phosphorus into alloys, and is still used, but has been largely superseded by the copper-phosphorous mixture because of its greater convenience, as it adds, besides the phosphorus, nothing but copper, which is usually the base of the alloy treated.

Both phosphor-copper and phosphor-tin are easily made if there was any economy in doing so. All that is required is to have

the metals in granular form and bury the phosphorus therein in a crucible of sufficient size to contain the entire charge before it is melted.

In making phosphor-tin, the tin is "shot" by being poured in a molten condition into water, an operation requiring care, as tin spatters as it strikes the water. The crucible is previously annealed, but should be quite cool when charged. A layer of the dried shot tin is placed in the bottom of the crucible, and the phosphorus can be placed altogether, or be distributed throughout the charge of tin, it seems to make little difference. When the crucible is filled with the properly proportioned charge it is placed in a furnace having a little fire in the bottom, and the phosphorus inflames and melts and alloys with the tin.

The same method can be followed with copper to make phosphor-copper, but as before remarked, it is unnecessary to run the risk of making it because it can be obtained so readily and at reasonable cost, from manufacturers who make a specialty of such alloys and have the skill and equipment at their disposal to make them with a minimum of risk. It is interesting, though, to know how they can be made without any of the fuss and feathers of the old fashioned methods that have been made public from time to time. On a large scale there are more direct methods of making phosphorized metals than the one involving the use of stick phosphorus and granulated metals. Ferro-phosphor, for instance, is made by smelting phosphate rock, iron turnings, silica, etc., in a suitable furnace, which may be an electric furnace of the arc type, and there is little doubt but that phosphor-copper could be made in a similar manner.

Large amounts of phosphor-copper were formerly imported from Germany, and a considerable quantity is coming now from France, although it is also made in this country.

Copper versus Aluminum

Dealing with the world's reserve of metals in a recent issue of the *Engineering Magazine*, Edwin C. Eckel expresses the opinion that, judging by actual conditions as to the known reserves and economic rate of output of copper, the indications are that whenever the industrial structure of the world gets into shape again, there may

be for some time a scarcity of copper.

While at this date the copper mining and capacity of the world is larger than it has ever been before, also owing to the development of the immense low grade ore supplies of the West, there is now a known and determined ore reserve far larger than ever before.

The Lake Superior district is nearing its end as an important producer, the known low grade deposits are now developed to somewhere near their maximum economic rate of output, and there is not in sight anywhere such a new tonnage as has been overhanging the market for the past decade while these Western deposits were being developed.

The price raising of copper, however, will eventually be limited by the competition of aluminum, which can replace it effectively for many important purposes. The development of aluminum can never be limited by scarcity of raw material, but only by manufacturing and marketing conditions.

With practically no exception the mineral called bauxite, a hydroxide of aluminum, is the source of all the present supply of that metal, and the known deposits of bauxite are alone sufficient to remove any great danger of ore scarcity in the near future. These ore reserves are far larger than the reserves of any other metals except iron, and there are also other possible sources of aluminum supply which might be turned to account in case of any deficiency in the bauxite supply. Aluminum is the only important metal in which patented metallurgical processes have played an important part in market control, and its price must be considered with this end in view. As to actual cost of manufacture, aluminum can be made at a cost slightly above the average cost of producing copper, and there is a possibility that this condition will be reversed within the next decade.

A new and very rich tin mine district has been struck in the Mersing District on the east coast of Jahore, Federated Malay States. From reports it would appear to be one of the richest "finds" discovered in the peninsula. Crowds of Chinese coolies have lately been arriving at Mersing bound for "the front." Huge concessions of land have been made in the district, and operations on a very large scale are expected shortly.

Advantage and Saving That Is Effected by Using Bar Anodes

By J. A. HALL

In the original instruction for nickel plating the exposed surface of the anodes is recommended to be slightly in excess of the work surface. I find this statement misleading. If the anode surface is equal to the work surface and the solution in good condition, the corrosion of the anode will nearly maintain the metal in the solution. Experience shows that the anodes dissolve more from the edge than from the center, showing that circulation around the anode is necessary to get the greatest amount of corrosion of the anode, therefore, bar anodes should be used.

I visited a plant a while ago where they were using the old style flat anode. The anodes were in the tub for two years and they were not more than $\frac{2}{3}$ worn out. The tub was a 500 gal. They used the tub every day, and in that time the anodes should have been worn out. Instead of using the nickel from the anode, they were using the metal from the solution. They used 25 lb. of nickel salts per week in the tub, at 9c. per lb. Nickel ammonia sulphate contains about 14 per cent nickel. They were adding about $3\frac{1}{2}$ lb. of metal per week to the solution at a cost of 63c. per lb. Now, then, if they had used the nickel from the anodes, the nickel anodes 96.97 per cent cost 48c. per lb., there would have been a saving of 15c. per lb., not figuring labor dissolving salts. Now, then, if they had used bar anodes, that had a circulation all around the anode, the corrosion would have been nearly double, and they would not have used over 25 lb. of salts per month, a saving of \$21 per year on one tub. That seems small, I know, but there is the point: I have 42 tubes of about the same size, all of which have bar anodes. Now 42 times \$21 equals \$882 a year saved on nickel salts. Does that pay? And, then, how about the scrap? A 500 gal. tub will take 500 lb. of nickel anodes; the flat anodes have 20 per cent scrap, or 100 lb., to each tub. The scrap costs 48c. per lb. and sells for about 20c. per lb. A loss of \$28 on one set of anodes. By using the bar anodes, as they wear away they give space between, so when there is a loss of anode surface, a new one is placed between the old ones. In that way the old anode

is left in as long as there is nickel on the hook, and the scrap is not over 5 per cent, or 25 lb., per set of anodes. Twenty-five pounds of scrap sells for \$5, cost \$12, loss only \$7 on each set of anodes of 500 lb. At the present time I am using 25 sets of anodes a year, 25 times \$7 equals \$175 a year lost on bar anodes from scrap. On the old style flat anodes my loss would be 25 times \$28, equals \$700 per year on scrap. I am not selling nickel anodes, but from the results I am getting from the bar anodes I feel that they deserve the credit I have given them.

Synthetic Ammonia

The Journal of Gas Lighting (London) states that a process which allows of gas producers being utilized to manufacture ammonia by synthesis has been devised by Herr Adolph Bambach. By its aid atmospheric nitrogen can be fixed in the form of metallic compounds, both carbureted and nitrogenous (cyanides, cyanomides, etc.), or metallic nitrogen compounds (nitrides), and these substances decomposed, either with saturated and superheated steam or with water, to extract the ammonia.

"Fifty per cent of the electro-plating of to-day is produced by men who have but the crudest ideas of electricity or chemistry, common sense is often displayed in negligible quantities and the product is seldom economically or efficiently treated. Horse sense coupled with a little ingenuity may hold a position for years, but a trained mind is less expensive to the manufacturer who desires to build and maintain a reputation for superior finished goods."—W. S. BARROWS, President American Electro-platers' Society.

The Engineering and Mining Journal says that the great rise in the price of zinc is causing cyanide mill men to begin a research for some substitute. One mine manager expresses the opinion that many a mill will ultimately turn to electrolytic precipitation. The desilverizers of lead bullion are also telling tales of woe with respect to how the present price for zinc has increased their refining cost.

The amount of tin to be recovered from old tins or tinplate scrap does not run higher than 20 to 40 lb. per ton.

TESTS OF NATURAL GAS-FIRED BRASS FURNACES

By FRED L. WOLF and ROBERT B. BURR*

The purpose of this paper is to summarize briefly the results obtained from a series of tests made under shop operating conditions, on various types of available brass melting furnaces, at the plant of the Ohio Brass Company, Mansfield, Ohio, using natural gas as a fuel. The object of these tests was to endeavor to increase the efficiency of the furnace by making use of the present equipment without entering into too great an expense for alterations.

The gas was obtained from the medium pressure mains and was conducted to the furnace through regulating valves, the volume having been measured by a Toby meter. The air necessary for combustion was obtained from an independent blower outfit, the volume being measured by a Westinghouse proportional meter. This independent blower was installed so that any air pressure up to 32 ounces could be obtained at will, as the highest available pressure, under factory conditions when all equipment was in use, was approximately, 14 ounces. The results of our tests showed that by a proper burner construction and manipulation, as efficient results could be obtained with 4 ounces of gas and 14 ounces of air, as with higher pressures, and with, of course, a consequent reduction in the cost of compressing the air. The gas and air meters were checked at intervals of four or five days and were found accurate within 1 per cent.

In these tests the same class of metal, consisting of brass ingots, weighing approximately, 20 lb. each, analyzing 85 per cent copper, 8 per cent zinc, 4 per cent lead and 3 per cent tin, melted and poured into the same class of castings at the same temperature. The furnace was operated throughout these tests by the same men under the direction of the authors.

The furnaces tested consisted of the following types:

First.—Preheated air, non-tilting, chamber type of burner, illustrated in Fig. 4, crucible furnace, designed for use with No. 60 pot. The general design of this furnace is indicated in Fig. 1.

Second.—Non-tilting, pre-heated air type, crucible furnace, in which the crucible is handled with a split shank, by elevating the furnace body by means of a rack and pinion. The construction is shown in Fig. 2.

Third.—Converted coke furnace of non-tilting pit type, shown in Fig. 3.

Fourth.—Open flame furnace, capacity approximately 800 to 900 lb. per heat.

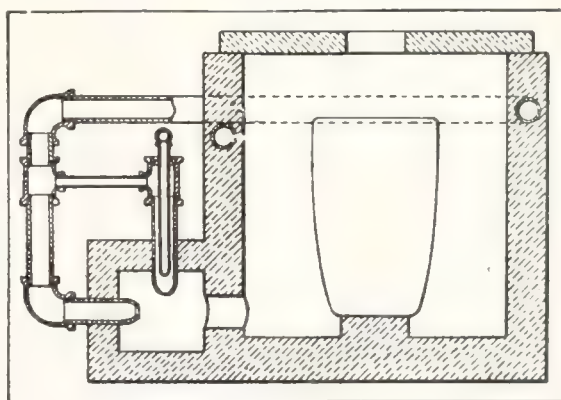


Fig. 1—Cross-Section of a Non-Tilting Crucible Furnace Designed for a No. 60 Pot

While the prime object of these tests was to increase the efficiency of the furnace and lower, if possible, the gas consumption, due regard was paid to the chemical composition of the furnace atmosphere to conserve the quality of the metal and prevent undue oxidation or scumming.

Frequent analyses were made of the furnace atmosphere by the Williams' type of Orsat apparatus, and our experience shows that with a neutral furnace atmosphere, or one containing a slight excess of carbon monoxide, not more than 1 per cent being found necessary, no oxidation of the molten metal occurred, and this without the neces-

*Presented at the Chicago meeting of the American Institute of Metals, as published in *The Foundry*.

sity of covering the metal with charcoal, coke, or glass, or other agents to prevent oxidation, the melted metal retaining its mirror-like surface.

It is true, of course, that the slight carbon monoxide content reduces the efficiency of the furnace as regards consumption of fuel, but this reduced efficiency is more than offset by the decreased shrinkage and superior quality of the metal.

Data sheet 1 shows the result of tests on the furnace illustrated in Fig. 1. Column 1 shows the data obtained on the trial tests before purchasing. It will be noted that in this column the gas consumption per 100 pounds of metal melted, corrected to 4 ounces pressure and 60 deg. Fahr. basis, is 351 cu. ft. As no records of air temperature and volume were kept, the ratio of gas to air is not given.

Column 2, *Data sheet 1*, gives the data for the same type of furnace after two years' operation. It will be noted that the gas consumption is the same, and the ratio of gas to air is 1:8.12. It will also be noted that 200 deg. of pre-heat was obtained, by circulating the air through pre-heating coils shown in Fig. 1.

Column 3, *Data sheet 1*, gives results obtained by using a pressure of 4 ounces of gas, 10 ounces of air, in the same furnace. It will be noted that the gas consumption is in considerable excess of the preceding test, consuming 451 cu. ft. per 100 pounds of metal melted. The ratio of gas to air has fallen at these pressures to 1:7.4 due to the burner construction and insufficient air pressure.

Column 4, *Data sheet 1*, gives the results obtained by using a gas pressure of 4 ounces, and 14 ounces of air pressure. It will be noted that the gas consumption per 100 pounds of metal melted, is 390 cu. ft., at a ratio of 1:9.07. The ratio of gas to air is a more efficient ratio than that shown in column 2. However, owing to reduced air pressure an inefficient mixture was obtained with this type of burner.

The increased gas consumption is without doubt, due to an inefficient mixture, or one in which stratification of gas and air currents are taking place.

We found that using natural gas of approximately 1000 B.t.u. per cu. ft., with gas corrected to 4 ounces pressure, 60 deg. Fahr. we obtained a maximum efficiency of 351 cu. ft. per 100 lb. of metal melted,

with a pre-heat of 200 deg. Fahr., and a gas and air pressure of 25 ounces. We found that the results obtained on the preliminary tests before purchasing can be maintained under shop operating conditions, provided sufficient air and gas pressure is available.

This type of furnace and equipment is open to the following objections: The burner is so constructed that it does not produce an efficient mixture of gas and air, unless relatively high pressures are used; the arrangement is such that part of the combustion takes place in the combustion chamber, the walls of which are thin, producing a relatively large loss to the surrounding atmosphere by conduction and radiation.

The burnt chamber is separated from the crucible chamber by a heavy lining which is pierced by a passage approximately 3 in. in diameter. This lining obviously, prevents the radiant heat from the walls of the combustion chamber heating the crucible. Due to the fact that part of the combustion takes place within the chamber, the heat generated causes this

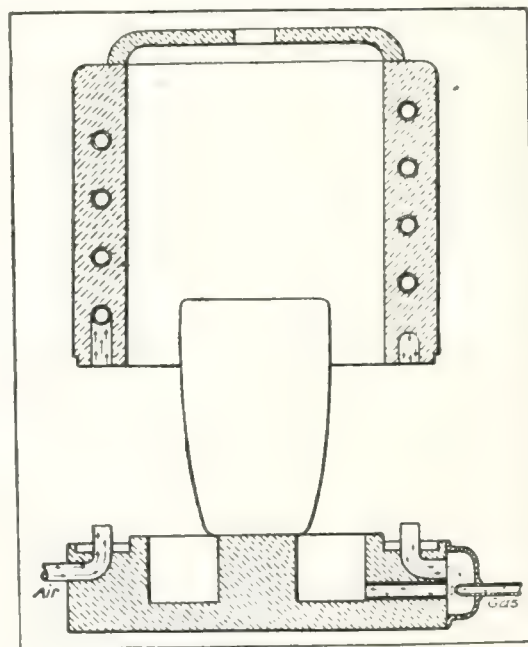


Fig. 2—Cross-Section of a Non-Tilting, Pre-heated Air Type Crucible Furnace

to become distorted, giving rise to a considerable loss of gas through leakage and increasing the repair item. The continual leakage of the gas makes it injurious to the furnace tender.

Results of Tests

Data sheet 2 shows results of tests run in the furnace illustrated in Fig. 2. Col-

umn 1, *Data sheet 2*, shows the data obtained by operating this furnace with the pre-heated air coil. It will be noted that to obtain efficient results, the air pressure must be maintained at 32 oz. The gas consumption corrected to be 4 oz. pressure, 60 deg. Fahr. per 100 lb. of metal melted, averaged 258.4 cu. ft., while the air corrected to the same temperature and pressure, showed a consumption of 1988.8 cu. ft., which gives a ratio of 1:7.68.

Referring to column 2, it will be noted that this furnace was operated with the pre-heated coils cut out. The gas consumption was increased to 321.23 cu. ft., or an increase of 19.7 per cent to 100 lb. of metal melted, with a ratio of 1:8.82. It will be further noted from a theoretical standpoint this ratio of 1:8.82 is more efficient than with the pre-heating coils, which was 1:7.68.

There unquestionably is a considerable increase in the efficiency due to pre-heating the air. It should be stated that owing to the type of burner employed, Fig. 2, it is not fair to credit the pre-heating of the air with 19.7 per cent increase, for the reason that owing to the type of burner with pre-heated air cut out, not so efficient a mixture of gas and air was obtained.

This furnace, from a mechanical standpoint, does not seem to be practical, the life of the lining, owing to the construction, particularly of the body of the furnace, would apparently be short. The furnace is inconvenient, and the men complain of the heat radiated from the base of the furnace when the body is lifted. Unless considerable care is used in properly sanding the base block, tendency was encountered, for the body of the furnace to become fused to the base. A great deal of care must be exercised in raising the body of the furnace, due to the fact that with the small base block employed, considerable danger of the crucible falling out of the furnace was encountered, making it necessary for the men to place the split shank in position as soon as the body of the furnace was lifted high enough to permit them to do so, it being found necessary for them to steady the crucible in this position until the body of the furnace was completely elevated. The cost of repairs on this furnace would no doubt be excessive in comparison with the cost of other furnaces.

Considerable difficulty was experienced

by the furnace tenders in properly inspecting the condition of the metal during the melting and also in adding the mix, owing to the fact that the hole in the cover was elevated above the floor line, approximately 4½ ft., bringing the metal closely on a level with the furnace tender's face which objection holds true of any elevated type of furnace, unless a platform is used. While the efficiency of this furnace is relatively high, its mechanical objections are many.

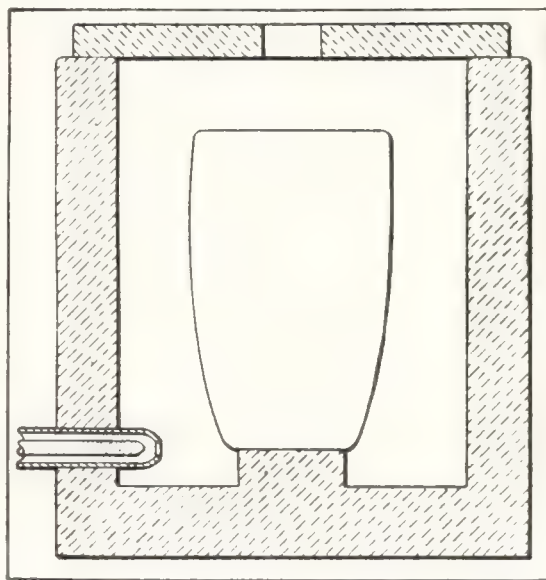


Fig. 3—Converted Coke Furnace of the Non-Tilting Pit Type

Data sheet 3 gives results of furnace tests upon a non-tilting pit type of converted coke furnace, equipped with a gas burner illustrated at A, Fig. 5.

Column 1 shows data obtained with a 1¼-in. tube type of burner with twenty-four 3/32-in. holes in the gas tube. While the gas consumption was comparatively low, still the time required per heat was equal to 58 min. Referring to column 2, the burner was enlarged in this case to a 1½-in. tube with forty-eight 3/32-in. holes. It will be noted that the gas consumption per 100 lb. of metal melted is equal to 344 cu. ft., this is 13.37 per cent higher than the results shown in column 1. Upon investigation, it was found that the burner entered the furnace at right angles, so that the flame impinged on the base block.

Referring to column 3, the same burner was used, the only difference being that the burner entered the furnace at a tangent and was so inclined as to produce a forward and whirling motion, without impinging on the base block.

The gas consumed is equal to 297 cu. ft.,

which is practically the same result as that shown in column 1, while the time element was reduced 8 min., the ratio of gas to air being 1:7.69.

This consumption of 297 cu. ft. is an increase in efficiency of 23.82 per cent over the burner and furnace shown in Fig. 1, employing a pre-heating coil, and operated with the same pressure, illustrating the fact that it is possible to construct, out of pipe and fittings, an efficient and economical burner which permits the use of low gas and air pressure, and which avoids the complication of renewing burner nozzles.

Column 4, *Data sheet 3*, gives results of 13 heats obtained by operating the non-tilting type of pit furnace, after same had been equipped with approximately 30 ft. of 2-in. pre-heating coil. This coil consisted of 18-in. lengths of 2-in. pipe fitted with the necessary ells and tees, and placed vertically, just inside the shell of the furnace, between it and the firebrick lining. These pipes were so arranged as to form a multiple path for the air, and contrary to our expectations, the numerous ells did not raise the air pressure necessary, due to the multiple path provided. With this arrangement the same type of burner was used as in tests tabulated in column 3, *Data sheet 3*.

Use of Pre-Heated Air

The pre-heating coils produced a rise in temperature of 347 deg. in the air used for combustions, and the time of the melt was reduced to 46 min., a shrinkage loss of 1.16 per cent. The ratio of gas to air, corrected values, was 1:8.55.

The apparent increased efficiency, due to pre-heating the air, was 14.8 per cent. It will be noted that the ratio of gas to air with pre-heating coil is 1:8.55, as against 1:7.69 without pre-heating coil, and this higher ratio of air to gas approaches more nearly the amount necessary for perfect combustion; it is, therefore, not fair to credit the entire saving of 14.8 per cent to the pre-heating of the air. This change in the ratio of gas to air illustrates the difficulty, under factory operation of maintaining a uniform ratio of gas to air, and accounts for the inconsistencies between special tests and shop operation. Considerable difficulty was experienced due to fluctuating gas and air pressure, which lead to an investigation of the possibility

of an automatic regulation of the gas and air pressure, to the end that a uniform ratio of gas and air might at all times be maintained in the burner.

Such apparatus has been designed and constructed, and the preliminary tests prove satisfactory, it being possible to regulate the gas and air pressure to less than 0.1 oz. and maintain automatically, any desired ratio between the gas and air pressure. However, sufficient data are not available at the present time to more fully describe this arrangement. It is, however, obvious that any method or system of burning with gas or oil, to produce uniform and consistent results, must be made in a large degree automatic, and as near foolproof as possible to produce maximum efficiency. Various factors must be considered, the

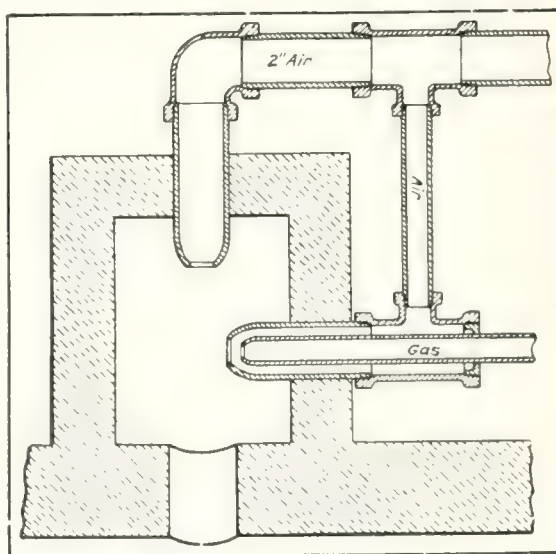


Fig. 4—Cross-Section of Type of Burner with which Furnace, Fig. 1, was Equipped

quality of the metal, the shrinkage loss, the proper furnace atmosphere, and the proper ratio of gas to air to produce same. To maintain this efficiency the furnace equipment should be so designed that the furnace operators cannot vary the predetermined ratio.

An attempt to increase the efficiency of mixing the gas and air was made by constructing a burner as illustrated at B, Fig. 5. This burner was tested, but the results indicated that the tube type of burner, shown at A, produced as efficient a mechanical mixture of gas and air as the more complicated baffle burners illustrated, and without reduced velocity of the gas and air in the burner. In other words, the mechanical mixture produced by the tube type of burner seems to be as efficient as

any of the more complicated methods described.

The tube type of burner used on the pit furnace is shown at A, Fig. 5. This burner was a considerable improvement over the chamber type, gas analyses showing practically a complete mechanical mixture of gas and air, which of course, is the prime object of any type of burner. The mixture is produced without appreciable loss of velocity and with relatively low pressures of gas and air, resulting in a consequent reduction in the power cost of air. On account of the ejector effect of the air on the gas tubes, temporary low gas pressure, while of course reducing the total amount of gas available, does not cripple the operation of the plant, making it possible for the foundry to remain in operation even if the pressure be reduced several ounces.

The burner may be constructed by the shop repair man, with the necessary pipe and fittings, which are always available, and its construction requires no machined parts, or complicated castings. The installation requires no complicated pipe fitting and the maintenance is practically nil. The burner will not burn out, due to the fact that it is not exposed to the temperature of the furnace, and is kept cool by the gas and air mixture. With this type of burner no leakage of gas, air, or the mixture ensues, due to the absence of any warping effect.

From the results of this investigation, it is apparent that the typical pit type of coke furnace, may be equipped at very slight cost, for the use of natural gas with resulting economy in the consumption of gas equal to any specially built natural gas furnace which has the same depth of lining and which does not employ a method of utilizing the heat of the waste gases. Substantially the whole cost of such an equipment is the necessary blower, pipe, fittings, and labor.

Advantages of Coils

The pit type of coke furnace has many advantages in saving of floor space and floor obstruction; it places the molten metal a considerable distance from the face or person of the melter; it is convenient for charging, and we can see no logical reason for discarding any pit type of coke furnace, the drums of which are in good repair, when changing to the use of natural gas.

Reference to the preceding data will show a considerable increase in the efficiency of the various types of furnaces tested, due to the use of coils in the furnace lining, which pre-heat the air used for combustion, and while these coils cannot be classed as devices for utilizing the waste heat of the products of the combustion, nevertheless, they tend to reduce the temperature of the outside of the furnace drums, and recover in a measure, considerable heat that would otherwise be lost through radiation. As previously stated, no serious difficulty was encountered in constructing these coils from pipe and fittings, nor was any difficulty experienced in their installation when converting the pit type of coke furnace to the use of natural gas. To date there has been no evidence of deterioration, after a period of several months' use, and we can see no logical

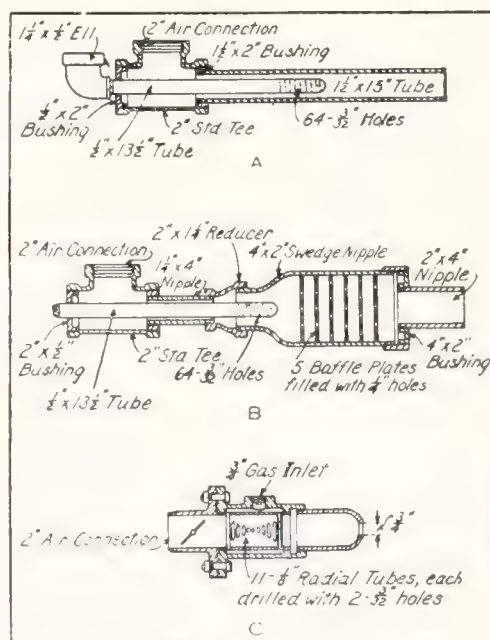


Fig. 5—Cross-Sections of Various Types of Burners Used

reason why their life should not cover or equal the life of the furnace drums. It is quite evident, from our experience, that the economy resulting from their use more than justifies their installation.

Data sheet 4 gives result obtained by operating a No. 2 open flame furnace with gas as fuel. Owing to the fact that time did not permit, we were unable to obtain the shrinkage loss. It will be noted that the gas consumption per 100 lb. of metal melted was equal to 199 cu. ft., corrected to 4 oz. pressure and 60 deg. Fahr. The class of metal melted consisted of equal parts of borings and brass ingots, which

Data Sheet No. 1

	1 Trial tests before pur- chasing	2 Chamber burner under factory conditions.	3 Chamber burner gas 4 oz., air 10 oz.	4 Chamber burner gas 4 oz., air 14 oz.
No. of melts	56	11	12	11
Metal weighed in, lbs.	8,469	1,688	1,875.5	1,695
Metal weighed out, lbs.	8,341	1,668	1,852	1,676
Loss in lbs.	128	20	23.5	19.5
Loss in per cent.	1.51	1.18	1.25	1.15
Min. required for melt.	49.4	45	53	45
Cu. ft. of gas used	29,000	5,800	9,027	7,055
Deg. Fahr. gas temp.	91	91	91	91
Gas press. in oz.	25	25	4	4
Metered gas per 100 lb. metal	343	343	481	416
Cu. ft. gas corrected to 4 oz. press., 60 deg.				
per 100 lbs. metal	351	351	451	390
Cu. ft. air metered		50,800	66,901	62,891
Air temp. deg. Fahr.		103	103	103
Deg. Fahr. air temp. before entering pre-heating coil	86	103	103	103
Deg. Fahr. air temp. after leaving pre-heating coil	276	303	303	303
Deg. Fahr. pre-heat	190	200	200	200
Air pressure in ounces	26	25	10	14
Air metered per 100 lbs. metal		3,009	3,567	3,716
Air corrected to 4 oz. and 60 deg.		2,852	3,338	3,535
Ratio of gas to air, corrected values		1:8.12	1:7.4	1:9.07
Per cent of cop in br's	79-80	79-80	79-80	79-80
Deg. Fahr. at which brass was poured	2100	2100-2200	2100-2200	2100-2200
Class of metal melted	Ingot	Ingot	Ingot	Ingot
Size of casting	Valve	Valve	Valve	Valve
Kind of meter used, gas	Toby No. 4 in all cases			
Kind of meter used, air	Westinghouse proportional in all cases			

Data Sheet No. 2

	1 With pre-heated air.	2 Without pre-heated air.
No. of melts	10	10
Metal weighed in, pounds	1,469.5	1,471.5
Metal weighed out, pounds	1,453.0	1,453.5
Loss in pounds	16.5	18
Loss in per cent.	1.12	1.22
Minutes required for melt.	58	56
Cubic feet gas used	4,309	5,680
Degrees Fahr. gas temperature, average	130.3	142
Gas pressure in ounces	4	4
Metered gas per 100 lbs. metal melted.	293.1	386
Cubic feet gas corrected to 4 ounce pressure 60 deg. Fahr. per 100 lbs. metal	258.4	321.23
Cubic feet air metered	29,618	46,995
Air temperature, degrees Fahr.	118.3	133
Deg. Fahr. air temperature before entering pre-heating coil	118.3	
Deg. Fahr. air temperature after leaving pre-heating coil	458.8	
Degrees Fahr. pre-heat	340.5	
Air pressure in ounces	32	14
Air metered per 100 lbs. metal melted.	2,015.5	3,193.6
Air corrected to 4 ounces and 60 deg. Fahr.	1,988.8	2,831.9
Ratio of gas to air, corrected values	1:7.68	1:8.82
Per cent of copper in brass	79-81	79-81
Deg. Fahr. at which brass was poured	2100	2100
Class metal melted	Ingot	Ingot
Size of casting, valves, inches	1 to 2	1 to 2
Kind of meter used, gas	Toby No. 4	
Kind of meter used, air	Westinghouse proportion	
Increased efficiency due to pre-heated air	19.7 per cent	

Data Sheet No. 3

	1 Pit tube 1 1/4-in. with 24 3/8-in. holes.	2 Pit tube 1 1/2-in. with 48 holes entering at right angles.	3 Pit tube 1 1/2 in. with 48 holes slightly inclined upward.	4 Pit tube 1 1/2 in. preheat coil of 30-ft. 2-in. pipe.
No. of melts	14	12	10	13
Metal wghd in, lbs.	2,147.5	1,745	1,460	2,061
Metal wghd. out, lbs.	2,117.5	1,725	1,442	2,037
Loss in pounds	30	20	18	24
Loss in per cent	1.39	1.14	1.22	1.16
Min. required for melt.	58	56	51	46
Cubic feet gas used	6,776	6,392	4,632	5,521
Deg. Fahr. gas temp.	91	91	91	88
Gas pressure in ounces	4	4	4	4
Metered gas per 100 lb. metal	318	367	317	268
Cu. ft. gas corrected to 4 oz. press. and 60 deg. Fahr. per 100 lb. met.	298	344	297	253
Cu. ft. air metered	56,510	27,560	36,500	46,051
Air temp. deg. Fahr.	92	118	118	95
Deg. Fahr. air temp. before entering preheating coil				
Deg. Fahr. air temp. after leaving preheating coil				442
Deg. Fahr. preheat				347
Air pressure in ounces	14	14	14	14
Air metered per 100 lb. metal	2,631	3,160	2,484	2,234
Air corrected to 4 oz. and 60 deg. Fahr.	2,567	2,908	2,285	2,163
Ratio of gas to air corrected values	1:8.61	1:8.45	1:7.69	1:8.55
Per cent of cop in br's	79-80	79-80	79-80	79-80
Deg. Fahr. at which brass was poured	21-2200 in all cases			
Class of metal melted	Ingot in all cases			
Size of casting	Valve in all cases			
Kind of meter used, gas	Toby No. 4 in all cases			
Kind of meter used, air	Westinghouse proportional in all cases.			
Increased efficiency due to preheated air	14.8 per cent.			

Data Sheet No. 4

	Open flame furnace.
Number of melts	21
Metal weighed in, pounds	16,223
Metal weighed out, pounds	
Loss in pounds	
Loss in per cent.	70
Minutes required for melt.	33,186
Cubic feet gas used	85
Degrees Fahr. gas temperature	10
Gas pressure in ounces	205
Metered gas per 100 pounds metal melted.	
Cubic feet gas corrected to 4-ounce pressure and 60 degrees Fahr. per 100 pounds metal	199
Cubic feet air metered	386,820
Air temperature, degrees Fahr.	100
Air pressure in ounces	14
Air metered per 100 pounds metal melted	2,384.4
Air corrected to 4 ounces and 60 degrees Fahr.	2,191
Ratio of gas to air, corrected values	1:10.68
Per cent of copper in brass	79-80
Degrees Fahr. at which brass was poured	22-2,300
Class of metal melted	Ingot 1/2, Borings 1/2
Size of casting	Valve
Kind of meter used, gas	Toby No. 4
Kind of meter used, air	Westinghouse proportional

accounts for the fact that the gas consumption is somewhat greater than if brass ingots alone had been melted. The ratio of gas to air was found to be 1:10.68, which is in excess of the theoretical ratio. No doubt the furnace atmosphere was an oxidizing one. No efforts were made at this time to obtain an analysis of the waste gases, and the furnace operation was left to the furnace tender, who judged the heat by the color of the flame issuing from the spout of the furnace. Cost of crucibles is a considerable item in melting cost of brass. Any statement of fuel cost per 100 lb. of metal melted in a crucible type of furnace should include crucible cost.

Copper and Silver Production in Michigan in 1914

The production of copper from the mines of Michigan in 1914, as reported by the U. S. Geological Survey, amounted to 164,344,058 pounds against 135,853,409 pounds in 1913. The production of silver in 1914 was 413,500 ounces, against 295,173 ounces in 1913. The value of the copper produced by the mines was \$21,857,759 in 1914 and \$21,057,278 in 1913. The value of the silver output was \$228,665 in 1914, against \$178,285 in 1913. The production of refined copper in 1914 was 158,009,748 pounds, compared with 155,715,286 pounds in 1913.

Practical Nickel-Plating Bath

By J. HASLIP

At present there is a great demand for a good quality in nickel finish, and while much has been written on the subject, most of the formulæ are very complex and misleading, and moreover the majority have proven deficient in practice.

There have been many changes in preparing nickel solutions, but at present sulphates of nickel and sulphate of nickel and ammonium with the addition of chloride of sodium and boracic acid, are used almost exclusively.

Too many chemicals in a solution cause reaction, the more simple the solution, the easier it is to operate, and it has been found that the best results are thus obtained.

A solution of the above mentioned salts is made as follows: To each gallon of pure boiling hot water add 9 oz. of sulphate of nickel and ammonium, and 3 oz. of sulphate of nickel (care being used that crocks or tanks have never been used for any other purpose).

The hydrometer for measuring liquids heavier than water placed in the above solution should stand at $6\frac{1}{2}$ deg. B., if it is lower, more of the salts in the above proportion must be added. If it stands above $7\frac{1}{2}$ deg. B., reduce by adding pure water.

The resistance in sulphate of nickel solution is very great, and it is advisable to add 10 per cent of chloride of sodium, this will aid in the conductivity of the solution, as salt is a good conductor of electricity. Boracic acid dissolved in hot water, 2 oz. to each gallon of solution, has the effect of clearing it up and will tend to produce a soft white deposit.

Whiteness of the deposit depends largely on the quality of the anodes and salts, and only the best grades should be used.

The deposit will never be of a pure white color when salts containing copper are used. The solution should never be poor in metal, the deposit forms more slowly and with less density than in a solution which contains the proper amount of metal.

To keep the solution in proper working condition, an occasional test with the hydrometer and litmus paper is necessary. The solution should be slightly acid to give a white deposit in plating.

Too much acid in the solution will cause pitting and peeling, and too much alkali or

sulphuric acid containing arsenic will darken the color of the work.

If the solution contains too much acid, the hydrometer should stand less than $6\frac{1}{2}$ deg. B., it shows the solution is robbed of metal and double salts should be dissolved in water and added until the proper amount is obtained. If it contains an excess of alkali, single salts are dissolved in water and added. If it contains the correct amount of metal and is alkali, boracic acid or chemically pure sulphuric acid should be gradually added until blue litmus paper is turned to a slightly pinkish color. In order to keep the solution saturated with metal, it should not go below 60 deg. Fahr., otherwise the salts will crystallize and will form on the tank and anodes. To make up for loss of drippage and evaporation, it will be necessary to add water from time to time.

The tank should be deep enough so that articles when suspended in solution will not come closer than within 6 in. of the bottom of the tank, thus leaving sufficient space for impurities to accumulate.

The anodes should be at least 95 per cent pure, and should at least equal in surface the article to be plated, but the larger the anode surface, the richer in metal the solution will be and the more economically the work will be done.

In suspending the anodes in the tank where copper hooks or other metals are used they must not dip into the solution, for in time they will contaminate it with other metal, thus affecting the color of the nickel deposit.

Owing to the fact that nickel does not readily dissolve, it is important that the anodes and also the hooks used in suspending them in the solution, should be kept clean and free from corrosion, otherwise the solution soon becomes impoverished and has to be built up more frequently with the metal salts.

One of the great secrets in successful plating and one to get perfect results from the solution, is to exercise every possible care not to bring articles containing greases or other foreign matter into it. Thoroughly rinse the articles with plenty of clean water so as to remove all traces of alkalies and acids used in cleaning. The different kinds of metals and classes of work require suitable baths for cleaning treatments; *it is necessary that articles to be*

plated have a chemically clean surface free from tarnish and oxidation.

Articles must not remain to dry in water or air for too long a period after being chemically cleaned, as a coating of oxide is formed upon them, and metals deposited over the oxide will not adhere firmly. Pitting of articles arises, from various causes, the principle ones are dust forming on the surface of the solution which sticks to the work while being suspended, *too much free acid, and when solutions are forced and overcrowded by using too high a current to reduce the time in plating.* It is not necessary to keep nickel solutions in constant agitation by mechanical means, as the articles being suspended and taken out of it daily gives it plenty of agitating. Any desired thickness of deposit may be produced providing the solution and current are properly regulated.

Articles that have been smoothly polished should only remain in the solution until a dull bluish luster appears, as all metal deposited after this occurs is buffed away in obtaining a high finish.

In operating the solution, dirt and sediment accumulate from anodes, impure chemicals, and from articles that have not been thoroughly cleaned before being suspended in it.

The dirt will settle on the articles and the deposit will be sandy and pitted. The solution should be allowed to settle for a few days; the dirt and sediment will settle on the bottom of the tank. The solution should then be drawn off by means of syphoning to within a few inches of the impurities. Care must be taken not to agitate the solution during the operation. After the solution has been drawn off, all rods, connections and anodes should be removed from the tank and should be scrubbed clean. Wash out tank thoroughly before returning solution. The solution will again be clean, and work coming from it will be glossy and much easier to buff.

If the above directions are followed, and carefully noting the condition of the solutions when the best work is produced, a little practice will enable operators to keep both the quality and quantity of work to the highest point of efficiency.

J. C. Carroll, West Haven, Conn.: "I have been a subscriber for at least ten years."

A Jewelry Tour de Force

One of the new sights of New York is the Bankers' Club, on the 38th, 39th and 40th floors of the new Equitable building. The furnishing has been considered a wonderful achievement and the club's quarters have been the subject of many articles in the press. Few know that the furnishing called for an achievement in the jewelry industry that is almost without a parallel, as it necessitated the designing and manufacture of about 22,500 pieces of silver plated ware in less than three months' time—ninety days from the time the order was given, and for this ware special dies and

Imports and Exports of Copper

The imports and exports of copper at the customs districts of New York, Massachusetts, Philadelphia, Maryland, Virginia, Galveston, New Orleans, San Francisco, Washington, and Michigan during the week ended June 26, 1915, were as follows:

IMPORTS			
Countries	Ore, matte, and regulus (copper contents)	Pigs, ingots, bars, plates, and old, etc.	
	Pounds	Pounds	
Canada	178,462	\$25,078	2,678,356 \$474,148
Cuba	4,698,066	98,731	558,000
Chile	1,520,091	214,908	858,478 132,508
Peru	19,572	1,340	1,013,719 159,977
Venezuela			129,628 18,148
Spain			1,321,698 233,424
Total	6,416,191	\$340,057	6,001,879 \$1,018,205
DOMESTIC EXPORTS			
	Pigs, ingots, bars, plates, and old, etc.		
	Pounds		
France		336,438	\$77,380
Italy		1,033,000	215,605
Russia, Europe		1,120,263	172,840
England		3,815,037	634,330
Scotland		362,580	54,913
Canada		260,000	48,454
Honduras		27	8
Panama		127	25
Mexico		4,833	1,112
Cuba		6,594	1,276
Argentina		480	116
Brazil		9,808	1,736
British Africa		6,166	980
Total		6,955,353	\$1,208,775

The possibility of a shortage of ferro-manganese, often discussed in the past year, seems nearer now than at any time since the war began. With constantly decreasing supplies of manganese ores at advancing prices, the recent order of the British Government that all producers and consumers of the alloy put aside a three months' supply before exporting any more and maintain such a reserve during the war is not surprising.

Deoxidizers for Non-Ferrous Metals

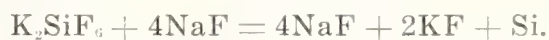
Silicon-Copper

Silicon-copper is a familiar alloy to most brass foundrymen at the present time, but like aluminum which in some respects it greatly resembles, it is a comparatively modern product. It was first produced in the United States by the Cowles Brothers who invented one of the first electric furnaces, and by its aid directly reduced silica with carbon and ultimately produced the silicon-copper of commerce.

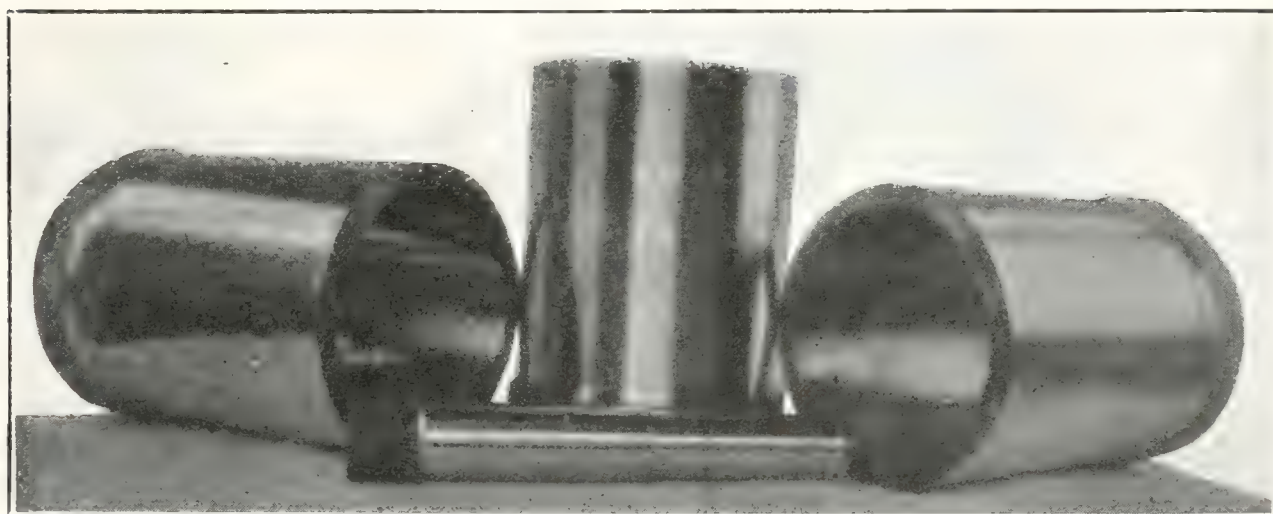
The principal use of silicon is as a deoxidizer of copper, in which respect it has never been equaled. Its only objection is that it reduces the electrical conductivity of the copper to which it is added, but for all copper castings in which the property of high conductivity is unimportant, silicon-copper furnishes the most satisfactory means of obtaining sound and clean copper castings. The addition of 1 per cent of a 10 per cent silicon-copper to molten copper reduces the conductivity of the latter to around 57 per cent. This adds a little

it combines with the latter metal to form a silicate, which is deposited in the form of a white powdery substance on the outside of the castings giving them a white coating, and also collects in little pockets and streaks making the castings rough and pitted. Silicon is used to a limited extent in yellow brass when it contains no lead, and exerts much the same effect as aluminum, as it prevents smoke and endows the alloy with great fluidity. When it can be used it is preferable to aluminum because it does not dross so badly.

Silicon itself is not a metal like aluminum, as chemically it is more nearly allied to carbon. It can be obtained from its oxide silica or sand by decomposition with carbon at high temperatures, or by heating the sand with potassium or magnesium, also by decomposing the chloride with potassium. It is usually made, however, by heating together potassium fluosilicate, sodium and zinc according to the following equation:



The zinc melts and acts as a solvent for



Silicon Treated Copper Castings

less than 0.10 per cent silicon to the copper, because a "10 per cent" alloy usually contains a little under that amount of silicon. Thus a very small amount of silicon makes a big difference in the electrical properties of the copper, in which respect it is more powerful than aluminum, as the latter element when added in the same proportion to copper only cuts the conductivity 23 per cent.

The deoxidizing value of silicon copper is almost entirely confined to copper; in brass and bronze it is used very little and then not in alloys containing lead because

the silicon, and the zinc is dissolved by hydrochloric acid to get the silicon, which by this method is obtained in the graphitic or crystalline state. When obtained by the reduction of its oxide as before mentioned the silicon takes the form of an amorphous powder. In this latter condition silicon would be extremely difficult to add to copper, because it burns easily in the air, consequently when it struck the surface of the molten copper the powdery silicon would have been converted to the dioxide, and therefore, would have no effect as a deoxidizer as it would have already combined

with all the oxygen it was capable of taking up.

The only manner in which silicon can be handled economically in brass foundry practice is, therefore, in the form of an alloy with copper, and fortunately it is very easy to get it in this form by forming an alloy of copper and ferro-silicon, which is comparatively cheap to make.

There are several grades of ferro-silicon, one contains around 20 per cent silicon and 80 per cent iron; another around 50 per cent silicon and 50 per cent iron, this latter grade, by the way, is very rotten and easily broken; another grade consists of 90 per cent silicon, 10 per cent iron; and a more expensive grade contains 95 per cent silicon and 5 per cent iron.

The 95 per cent silicon alloy is the one to use in making silicon-copper. It comes in bright shining chips of a bluish purple color, and is very light and clean. The alloy should be broken into small grains, and can be either added to the molten copper gradually with stirring, or the copper can be granulated and arranged with the ferro-silicon in alternate layers in the cold crucible, and the whole melted down together in a very hot furnace. The latter is probably the best manner of making the silicon copper, and to make the 10 per cent alloy the following percentages should be taken:

95 per cent ferro-silicon . . 12.00 per cent

Granulated copper 88.00 per cent
or if the metric weights are used take:

95 per cent ferro-silicon 1200 grammes

Granulated copper 8800 grammes

When the charge is thoroughly molten, the mass should be vigorously stirred with a graphite stirrer; the crucible removed from the fire and contents poured into ingots. The resulting alloy should be very brittle, of a silvery color and should shiver like glass when struck. Care must be used in handling the alloy, or nasty cuts may result.

When made in the manner stated the analysis will show around 9.85 per cent silicon, with iron around 0.3 per cent, lower than would be expected as some is probably slagged off as a silicate. The loss in making this alloy will be around 5 per cent.

When silicon-copper is used to make copper castings of high conductivity, as is sometimes the case, only a very small amount of silicon must be added to the copper, and the latter must be brought to the tough pitch

condition in the furnace by "poling" before the silicon addition is made, then the latter element merely protects the copper from further oxidation while on its way to the molds and during the interval of casting and solidifying. By this means a conductivity of 80 per cent can be obtained, but the method is not practicable for the crucible method of melting the copper, as the poling operation would throw the copper out of the furnace and result in great loss of copper.

A Novel Core

At one of the branch meetings of the British Foundrymen's Association, held recently, one of the members gave his experience in chill casting manganese bronze. He stated that he had tried steel spindle cores, winding them with string spirally, and coating the spindle and string with new sand. The string was used presumably to allow the core to shrink or to permit withdrawal of the spindle after the casting was poured, as this is what was done. The scheme, however, was not really a success. The next thing tried was to machine grooves in the spindle and to drill fine pinholes in the grooves; the spindle was no doubt hollow and the drill holes acted as vents for the coating of sand. The speaker failed to state, however, how much sand was put on the spindle, whether the grooves were merely filled and the metal was allowed to contact with the steel between the grooves or whether the entire spindle was coated. It is probable that the spindle was entirely coated with sand which was swept on, and we should think the scheme would be more expensive than making sand cores.

Booklet About Graphite Brushes

Operators of electric power machinery are interested in the subject of commutation. A large percentage of break-downs in the present-day motor or generator must be charged against improper operation of commutator and brushes. Graphite brushes are designed with the purpose of reducing commutator troubles to a minimum. A booklet, "Dixon's Graphite Brushes," explains how the characteristic lubricating qualities of graphite are utilized to this end. A complimentary copy may be had by addressing Joseph Dixon Crucible Co., Jersey City, N. J.

The Cleaning Problem

By W. H. W.

From time to time there appear in trade journals articles on the proper cleaning of work for electroplating, but the majority of these articles, although they contain much that is good, lack the continuity of thought necessary for a complete analysis of cleaning problems. It is the purpose of this article to summarize facts about cleaners, to outline a course of reasoning preparatory to selecting a cleaning material, thus enabling the plater to choose the right cleaner for his class of work.

Before discussing the cleaners themselves, it is good policy to examine, if possible, the nature of the substance to be removed or rather the nature of the agent retaining the substance, for after all, it is not the particles of dirt that we seek to attack, but the binder which causes the dirt to adhere. Dirt of almost any nature such as rouge, silica, emery, etc., in a dry state, has no adhesive properties of its own, but when coated with oil or grease gives the plater no end of trouble with its resistance against attempts at removal.

Binding substances fall under one of two convenient heads, namely, mineral and vegetable. By far the greater percentage of binders fall in the mineral category since the majority of work to be plated is previously polished, buffed and colored, and paraffine is one of the cheapest binders known for abrasives. Among the vegetable binders might be mentioned soaps, cottonseed oil and other oils used in stamping and drawing. Fish oils, being saponifiable, may be classed among the vegetable binders. Thus we see we must provide cleaners for mineral and vegetable (including marine) products or, unsaponifiable and saponifiable substances.

For our purpose we may distinguish different methods of cleaning as follows:

1. Solution.
2. Saponification.
3. Emulsification.
4. Friction.

Platers know, and usually from experience, that alkalis will not attack mineral oils and, probably after having tried several commercial cleaners sold under various trade names and for which much is claimed, they know also that the only successful method for removing mineral oil or grease

is by dissolving it in some other mineral oil, the commonest oils being benzine, gasoline, carbon tetrachloride, naphtha, benzole, light paraffine oils, etc. The film of solvent retained by the work after immersion is removed with sawdust. This method comes under heading number one.

The removal of saponifiable matter falls under the second, third and fourth heads, all three methods sometimes, and the second and third usually, being combined in one cleaning solution. In theory the cleaning action of alkali on saponifiable matter is similar to soap making. Hot alkali hydroxide reacts chemically with the common oils and fats forming metallic salts of the fatty acids contained and separating glycerides. Emulsification is the softening and loosening action on dirt while friction includes all mechanical means of removal such as cleaning by hand, scratch brushing, sand blasting and electric cleaning, which is nothing more than the loosening of dirt by the friction of the hydrogen gas bubbles liberated by the electric current.

A cleaner embodying all three of the methods, namely, saponification, emulsification and friction would be an electric cleaner composed of alkali and containing a small amount of soap. Hot alkali by itself makes use of methods numbers two and three, the first by saponification and the second by emulsification through the soap, the product of the first reaction.

Examining the above methods closely we find that the cheapest and best way to remove mineral oil is to employ the cheapest, least volatile and best solvent mineral oil possible. These qualities may not always be found together, but with a little experimental work a happy medium can be found.

For the treatment of vegetable and marine products the cheapest and strongest alkalis should be sought. By strongest is meant those alkalis containing the highest percentages of alkali oxide calculated as Na_2O or K_2O . At present caustic soda, soda ash and sal soda are used extensively, potash being gradually retired by the cheaper and equally effective soda ash. The cessation of potash imports from Europe has forced the few "hangers-on" to join the ranks of the caustic soda users.

The question of precedence of caustic soda, soda ash and sal soda must be answered by the plater, since all three salts form the same salt, sodium hydroxide, in

hot water solution, and preference for one over the other resolves itself into a comparison of the relative price of each based on the content of Na_2O .

The statement made by some manufacturers that the percentage of Na_2O does not determine the value of a cleaner is absurd and unfounded. It would be just as incorrect to say that the amount of finished product in soap manufacturing were independent of the amount of alkali used. The majority of cleaners on the market consist of various combinations of soda ash and caustic soda with occasionally a small percentage of organic matter, usually resin. For practical purposes the plater will find that he can make up a very efficient cleaning solution with from one to two pounds of soda ash and from two to four ounces resin per gallon of water used hot. This solution may be used as an electric cleaner or without the electric current and it will not tarnish the work.

Aluminum hydroxide and sodium acid phosphate have been placed on the market as possible cleaners. The former has some merits, but it falls below sodium and potassium hydroxides in strength. Sodium acid phosphate hydrolyzes very slightly and is therefore incapable of forming much sodium hydroxide.

In conclusion, the following steps are recommended before a cleaner is decided upon:

First. Ascertain the binder holding the dirt it is desired to remove.

Second. Select the most desirable of solvents.

Third. If an alkali is necessary select that one which contains the highest percentage of Na_2O .

Fourth. Whenever possible add a little soap to the alkali to get the combined effect of saponification and emulsification.

Fifth. When it is necessary to use an electric cleaner, use the same solution suggested in (4), as this will give three distinct cleaning operations in one solution.

Tests For Oil

The latest advice on the subject for testing oils approximately to arrive at quick results for value and purity is found in the *Jeweler's Circular*. It says the most common and simple method is by comparison. Several drops of oil, each of a differ-

ent quality, are placed side by side on the surface of a small glass plate. They are then exposed to the air for some time without being touched; the one that is found to be sticky under the touch of the finger, the others being either yet thin or dried up, is the one to be preferred. Another test is that with a whetstone. An oil that will take a longer time to thicken on a whetstone is considered the best. Yet another test is that of substituting the whetstone or the glass with a brass plate. Oil that is left on brass for several days, at the expiration of which a discolored border or stained mark is left, is considered of bad quality. These tests should be carried out in two ways, i.e., by exposure to the air and in covered receptacles.

Copper prices since 1850 have fluctuated from 22 cents per pound average in that year to 47 cents in 1864, to $9\frac{1}{2}$ cents in 1894, 20 cents in 1907, and $13\frac{1}{3}$ cents in 1914. Latest quotation is $19\frac{1}{2}$ cents.

Device for Computing Values of Tungsten Lamps

It is well known that a change in the voltage applied to the terminals of an incandescent lamp changes the candlepower, current, and in consequence the wattage ($\text{watts} = \text{volts} \times \text{amperes}$) and the watts per candle. If these changes are followed from point to point, relations among the variables may be found and plotted as characteristic curves. The equations of these characteristic curves for tungsten lamps have been found by the Bureau of Standards.

According to the specifications of a recent patent, tantalum can be advantageously alloyed with nickel. An alloy with 30 per cent tantalum is non-magnetic, can be easily rolled, forged and drawn, and is equal to steel in elasticity and tensile strength. It is not attacked by boiling aqua regia or other acids, and is not oxidized when heated in the air.

In a patented method for hardening and welding copper the latter is heated to a cherry red and is treated with sodium "hyposulphite" and acetic acid.

Mixed Metals—Plumber's Red Brass

Red brass is really an imitation bronze. Its color is the same, or very similar to that of the more expensive copper-tin alloys, but it lacks their strength and toughness. It is used in situations where neither strength nor toughness is required, but where ease of machining and good casting qualities are essential. Red brass is composed of copper, zinc, tin and lead, in which usually the zinc content exceeds the sum of the lead and tin combined. It is used for a large variety of purposes, including electric railway overhead fittings and for plumber's cast brass work. For trolley fittings an alloy consisting of copper 85 per cent, zinc 10 per cent, lead 3 per cent and tin 2 per cent, finds considerable application.

For plumbing castings the lead is usually considerably higher, and the zinc may also be a trifle higher, with tin about the same. Too much zinc, however, is inadmissible, otherwise the color of the finished castings will too much resemble yellow brass.

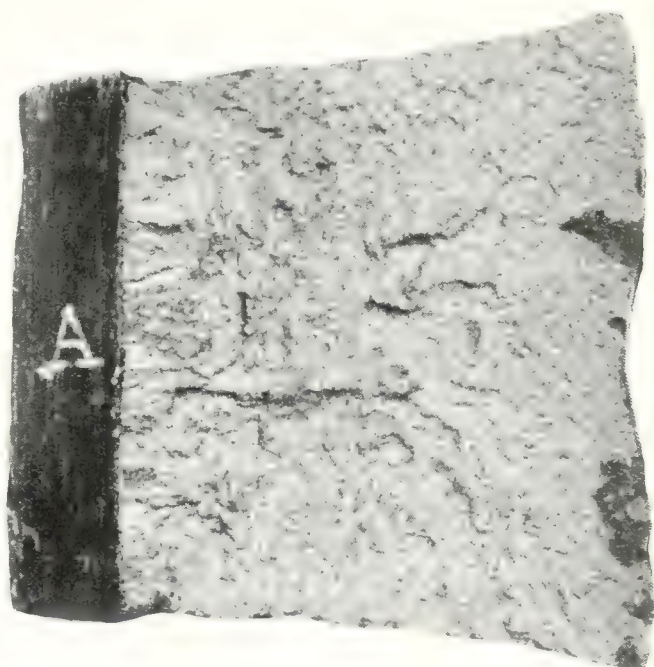
As this alloy is used in great quantities by the plumbing trade, the tremendous increase in the price of zinc has seriously affected the industry and as a result, where once new metals were used exclusively, scrap metals have taken their place; but with everyone using scrap metals this source of supply will soon be curtailed, if not exhausted.

The heterogeneous composition of the scrap is also a bad feature, as the color of the machined surfaces is liable to vary from heat to heat ranging from yellowish to red, according to the zinc content of the particular scrap melted, and the color of the unfinished surfaces will be dull and lacking in the bright color usually associated with good metal. For these reasons new metal is much preferable to scrap, but with zinc costly and difficult to obtain the old mixtures have become too expensive to use with the freedom of the past.

There is only one direction in which these mixtures can be changed, that is by increasing the lead and decreasing the zinc, and the limit in this direction is soon reached. The red brass alloy owes its toughness to the zinc, its color and easy machining qualities to the lead, and its strength to the tin. By increasing the latter we increase hardness and strength, and incidentally the cost, all of which is unde-

sirable. By decreasing the zinc alone we automatically increase the percentage of all the component parts of the alloy, but the copper most of all, because copper is the base, therefore, if we decrease the zinc the only component that can counteract the increase in cost is the lead, and as a consequence this element assumes the most important position in the alloy next to the copper.

But as before remarked there is a limit to the amount of lead that can be incorporated in the alloy, because lead is a weakener, owing to the fact that it does not alloy with copper, except in very small



Fractional Surface of Red Brass Ingot. Black Spots at Right Side Are Dross.

proportion, but is merely held in suspension.

In bearing metals, 15, 20 and 30 per cent of lead is often used but such alloys are unsuited for the uses to which red brass is put because their content of tin is comparatively high, making their cost equal to a more suitable alloy containing less lead; or they are difficult to cast without dropping the lead.

The only alloy that would possess any qualifications in this connection is composed of copper 78 per cent, tin 7 per cent and lead 15 per cent, and for many purposes where red metal has been used in the past, this alloy is entitled to consideration. We believe, however, that for many of the purposes for which red brass is used, and notably plumbing work, the following alloy

would prove more satisfactory in a general way. The alloy follows:

Copper	85.00 per cent.
Lead	8.00 per cent.
Zinc	5.00 per cent.
Tin	2.00 per cent.

This forms a good, conservative alloy, and while not entirely new to the plumbing trade, is not generally known. In practice the content of lead is often increased to 10 per cent, instead of 8 per cent, but this is not always desirable. When 10 per cent of lead is used, the cop-



Fractured Surface of Red Brass Ingot

per, of course, is cut to 83 per cent, and while this alloy may be perfectly satisfactory for many of the purposes to which red metal is put, the alloy as given is considered the best suited for making castings for the plumbing trade. The illustrations show red brass fractures.

Monel Metal Mystery

The curious action of sea water, steel and perhaps something of stupidity among designers, has caused the junking of half a million dollars worth of pleasure yacht.

Within a month or two much has been written and pictured concerning the rich Mr. Cochran's auxiliary yacht Sea Call, that has had just six weeks of life, and has had to be broken-up to prevent sinking. The technical press, especially, seemed to have much opinion to express flattering to the use of monel metal. The plating seems to

have been fastened to the steel frames without the interposition of zinc, as is said to be the successful practice in the navy, and today, owing to the violent action of the electrolysis that started up, the ship is crumbling apart, and is being wheelbarrowed to the scrap pile.

It would have been interesting to read some sort of warning as to what could be the result of a careless handling of the metal under the conditions that were patent, but such observations must have escaped us.

Trade Opportunities

The names and addresses of subscribers who have sent in any of the following inquiries will be furnished to any of our advertisers on application.

Inquiry No. 20—Carboy Truck

In a recent report issued by the Interstate Commerce Commission, there was illustrated a carboy truck, which was something on the order of a carboy rocker on wheels, used to transport acid in carboy to different parts of the plant.

Will you please advise whether from your files you can tell us the name of the manufacturer of this article, as we are interested.

Inquiry No. 21—White-Metal Fluxes—Remelted Spelter

Please give us the addresses of firms that we can buy metal fluxes from; also outlet for remelted spelter which we make.

Inquiry No. 22—Manufacturers of Soft Brass Wire

Could you inform us as to who are the manufacturers of soft brass wire? We are unable to obtain this wire in Canada. Kindly let us know, if possible, where we could get same.

Inquiry No. 23—Scrap Brass Buyers

Can you furnish us with a list of firms who make a practice of buying scrap brass of all mixtures?

Inquiry No. 24—Galvanizing Material Zinc

Please quote us on galvanizing material zinc for the hot dip process.

"Keep your eye on The Brass World."

FROM AMBER TO DYNAMO

Part IX—Design of Plating Room Conductors

By H. E. Willmore, Jr., B.S.

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Since there is some energy wasted in every conductor carrying an electric current, the problem of choosing a size of conductor resolves itself into a problem of economically balancing the cost of copper against the cost of producing electrical energy. In transmitting electrical energy, the problem of arranging the tanks to the greatest working advantage and securing a sufficient supply of electrical energy, without too great a voltage drop between the dynamo and each tank, is usually presented to the plater more forcibly than the problem of saving copper, and if correctly solved may represent real economy. In locating the dynamo and laying out the plans for the electrical conductors the following points should be observed:

1. Locate the dynamo where the shortest length of conductor will be required.

2. Locate the tanks requiring the heaviest current nearest the dynamo, unless this interferes with the most efficient labor conditions.

3. Take into consideration the amount of power required at each tank location for several years ahead, as well as for the time of installation.

Do not fail to give proportionate weight to all problems of laying out the plating room, such as the lighting, ventilating, drainage and the sequence of operations.

Where there are no objections to this kind of a layout, it is advisable to place the tanks requiring the largest current nearest the dynamo. Fig. 14 showed tanks 1 to 4 arranged with the largest tank *T*, nearest to the source of energy. Such an arrangement means economy in copper conductors, because it allows better "tapering" of the conductors. By "tapering" is meant the changing of the size of conductors to agree with the maximum safe current carrying capacity. The sizes of conductors chosen depend upon the maximum amount of current required by each tank and upon maximum current required by the entire room at

any time. Determining in advance the amount of current required by each tank is not always a simple job, because of the number of factors which vary the current.

The correct amount of current for a plating solution is usually expressed in the form, ND_{100} = a certain number of amperes. This means that for every 100 sq. in. of surface to be plated, the normal current density is the number of amperes specified. This number multiplied by 6.45 will give the number of amperes necessary for 100 sq. in. of surface, which is probably of more value to the plater. In most cases it is difficult and nearly impossible to calculate directly the square inches of surface possessed by the articles to be plated; but this may be arrived at in another way. The anode surface exposed is supposed to be at least equal to the surface of the cathodes, except in the case of silver and gold, and if the calculations are based on anode surface we may arrive at a good approximation of the maximum current likely to be required for the tank. As anodes are usually flat or elliptical in form, it is comparatively easy to compute their surfaces. For example, suppose a small nickel tank has ten anodes each 8 x 14 in. The surface exposed = $8 \times 14 \times 2 \times 10 = 1240$ sq. in. Suppose also that for this particular solution $ND_{100} = 0.4$ amperes. Then the largest amount of current that this tank

1240

will ever use safely will be $\frac{1240}{100} \times 0.4 \times$

$6.45 = 32$ amperes. It must be understood that this sort of calculation can give one only approximate results, as the proper current density will vary with the temperature at which the bath is worked, and the amount of surface being plated will vary also; but this calculation is at least a guide and considerably better than rule of thumb. The following normal current densities are based on values found in Langbein's "Electro-Deposition of Metals." I have given the

amperages in terms of amperes per 100 sq. in. of surface.

Nickel 2.25 to 3.25 (according to density and temperature of solution and additional conducting salts present).

Brass 1.9 to 3.25 (also according to density and temperature of bath).

Cyanide copper 2.25.

Acid copper up to 12.9.

Silver 1.9.

Gold 0.65 to 1.0.

Since silver and gold anodes are not usually nearly as large as the objects to be plated, it will be necessary for the plater to make an estimate of the amount of surface to be plated. With agitation, of course, all of these solutions will take more current.

The size of conductors leading from the main busbars to each tank should be just large enough to safely carry the maximum current demanded by each tank. There is actually no definite current carrying capacity for a certain size, any more than there is a definite number of gallons of water per minute which will pass through a certain size pipe. The current is only limited by the fusing point of the conductor. On the other hand, it has been found that certain sizes of conductor for certain currents represent safety and economy. The conductors must be large enough to carry the power without wasting it, and at the same time an increase in size above this point does little good and merely serves to increase first cost. When one considers that the conductors used average some pounds to the foot, it is well to figure this item rather closely. The term "safe current carrying capacity" requires some explanation. As the current passes through the conductor, a loss of power occurs which is equal to I^2R . This lost energy is converted into heat and raises the temperature until the amount of heat radiated becomes equal to the amount generated, at which point the temperature becomes constant. Ordinarily this maximum temperature must be kept below the point at which the insulation chars or vulcanizes. With the size of conductors and mode of insulation used in the plating room, a safe allowance is 1000 circular mils (one circular mil is the area occupied by a circle 0.001 in. in diameter per ampere for copper and from 1200 to 1400 for brass. These figures correspond to 0.00303 lb. per ampere-foot for copper and from 0.00343 to 0.0049 lb. per ampere-foot for brass. To make use of

these latter figures in figuring costs, multiply them by the number of amperes to be transmitted, times the distance in feet which the current is to be transmitted, and times the cost per pound of the metal. This will give the total cost of metal to transmit the current the required distance. For carrying the power to the tanks, solid bars of pure copper should be used. The conductors across the tanks themselves, for carrying the anodes and the work, may be of seamless brass tubing, because they have greater rigidity for a given cross-sectional area. Copper rods are ordered by B. & S. gage up to 0000, corresponding to 0.46 in. in diameter, beyond which they are designated by

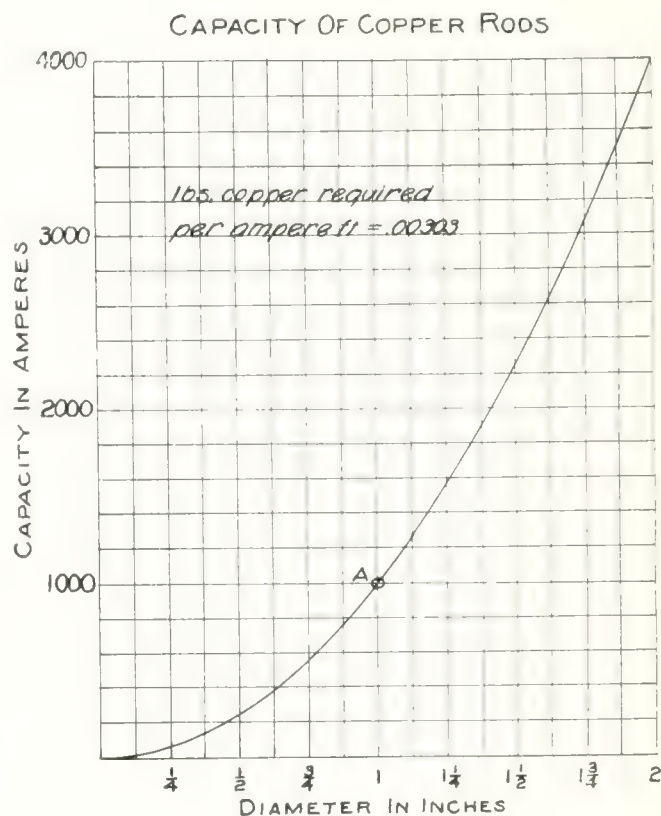


Fig. 15

diameters, which range up to 2 in. Conductors are also made square or rectangular and these may be had in any size desired. In ordering brass tubes, the plater should specify the diameter, which varies by eighths of an inch from 1/4 in to 3 in. The outside diameter is usually understood; but this should be clearly specified. The thickness of wall conforms to the Birmingham or Stubs wire gage.

For convenience in calculating size of conductors and tank rods for different loads, I have prepared several curves, one giving the relation between size of copper rods and their current carrying capacity and the other giving the current carrying capac-

ities of various sizes of brass tubing. As some of my readers may not be familiar with the use of curves of this kind, a little explanation may be necessary. Taking the curve entitled "Capacity of Copper Rods," Fig. 15, distances of points on the curve measured horizontally to the right from the upright axis are proportional to the diameters of the rods, while distances measured vertically upward from the horizontal axis are proportional to the current carrying capacities of the rods. Point A, for instance, represents a diameter of one inch and a capacity of 1000 amperes. Taking another example, suppose the plater figures he needs a conductor to carry 2500 amperes. Finding 2500 on the vertical axis, he runs his eye along the horizontal line through 2500 to where it meets the curve. From this point, running down vertically to the horizontal axis, he finds that the nearest convenient size of copper rod is 1 5/8 in. in diameter. The brass tubing curves, Fig. 16, are used in a similar manner. For example, if he wants a tank rod to carry 600 amperes, he finds by referring to the curves, that he can choose between six different sizes: a 1 in., No. 2 gage; a 1 1/8, No. 4 gage; a 1 1/4 in., No. 6 gage, etc. In making the calculations for the brass tubing curves, I have allowed 1400 c.m. per ampere. Below I list a few of the more common sizes of copper busbars, with their current carrying capacities.

Size, Inches	Capacity, Amperes	Size, Inches	Capacity, Amperes
1x1	1275	1 1/2 x 1 1/2	2870
1x1 1/2	1910	1 1/2 x 2	3825
1x2	2550	1 1/2 x 2 1/2	4780
1x2 1/2	3180	1 1/2 x 3	5735
1x3	3825	2 x 2 1/2	6375

Other sizes may be figured by allowing one square inch of cross-section of the copper for every 1275 amperes.

Having determined the size of conductor for transmitting energy from the busbars to each tank, we are ready to consider the size of conductors to be used as main busbars. The designer must consider the load factor of the tanks, the probable increase in the volume of work, and the possible demand for new equipment. The conductor leading from the dynamo to the first junction with tank conductors (see $P-P_1$ and $N-N_1$, Fig. 14*) should be capable of carrying the full load current of the dynamo; while that part of the busbars carrying cur-

rent to the last tank (P_3-P_4 and N_3-N_4 , Fig. 14) need be only as large as the tank conductors. It often occurs that the full load capacity of the dynamo is only 70 to 90 per cent of the total amperage required by all the tanks, if loaded to their full capacity. A dynamo may have been so selected because it was decided that all of the solutions would never be worked at one time. In this case, the sizes of busbars should be figured by beginning with the tanks located farthest from the dynamo and increasing this at each tank connector until a size large enough to carry the total capac-

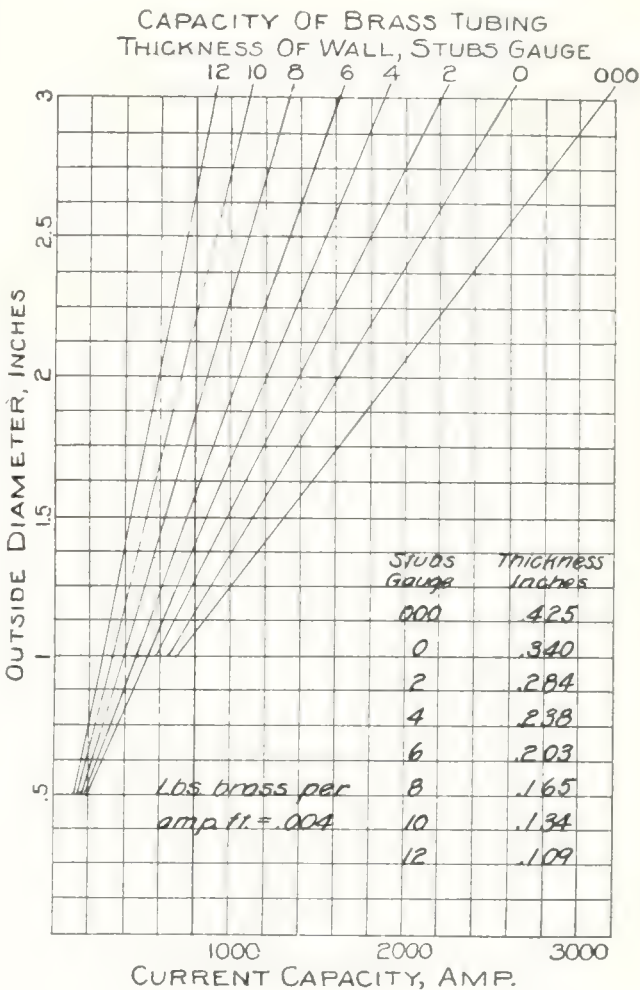


Fig. 16

ity of the dynamo was reached. It is of course wasteful to increase the size above this point.

Suppose, for example, that a dynamo was placed at B in Fig. 14, having a normal full load capacity of 1500 amperes and suppose that the requirements of the tanks were: $T_1 = 800$, $T_2 = 600$, $T_3 = 500$ and $T_4 = 300$ amperes. The full load capacity of the machine requires circular rod 1 1/4 in. in diameter. T_4 requires that P_3-P_4 and N_3-N_4 shall be 5/8 in. in diameter. P_2-P_3 and N_2-N_3 must

*See July BRASS WORLD.

carry the current to T_3 and T_4 , and therefore must be $\frac{7}{8}$ in. in diameter. In the same way it is found $P_1 P_2$ and $N_1 N_2$ must carry 1400 amperes, or nearly the full load of the dynamo and the nearest size is $1\frac{1}{4}$ in. in diameter.

In rare cases, where the dynamo was bought to take care of a rapid future growth it may exceed the total current required by the present tanks. In such cases the determination of size of conductors should proceed as though the future equipment were in place. If the future equipment has not been definitely decided, it may be advisable to proceed with the determination of size of conductors in the following manner: Determine the size of conductor necessary to carry the capacity of the dynamo. Taper this by decreasing the size of the bus at each tank by an amount equivalent to the current required by that tank. For example: a 2500 ampere dynamo would require a rod $1\frac{5}{8}$ in. in diameter for $P-P_1$ and

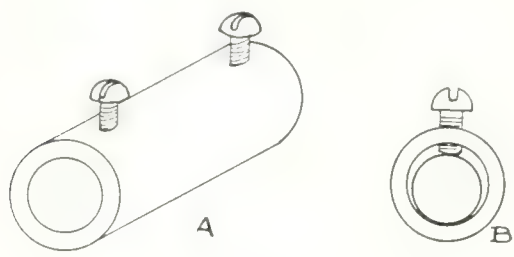


Fig. 17

$N-N_1$ and if T_1 required 800 amperes, $P_1 P_2$ and $N_1 N_2$ should be large enough to carry 1700 amperes or $1\frac{3}{8}$ in. in diameter. When the busbars are figured in this way, little loss should result from new installations of tanks, because the rods may be shifted to new locations.

Up to one inch in diameter, copper rods may be obtained in coils of any length. Large sizes of copper rods, however, are hard to straighten out and bend to the proper shape; hence they are generally furnished in lengths of ten feet or so. These bars are connected together with brass connectors of the general style shown in Fig. 17-A, being made also in ells for corners and T's for tie-in connections. These connectors have the fault that contact occurs only in two points as shown, somewhat exaggerated, in Fig. 17-B. To obviate this difficulty of poor contact, I would suggest that the ends of the rods be threaded with pipe thread dies, and brass connectors made by boring out and threading each end of a solid bar several

inches long. Since most plating rooms are located in factories that have machine shops, the manufacture of these connectors and the threading of the ends of the rods should be convenient and inexpensive. The flat busbars can be bolted together. It would be advisable, if possible, to solder the two faces together before bolting, thus insuring a better contact.

Fig. 18 shows a circuit designed to permit the reading of the amount of current flowing through any tank by means of one

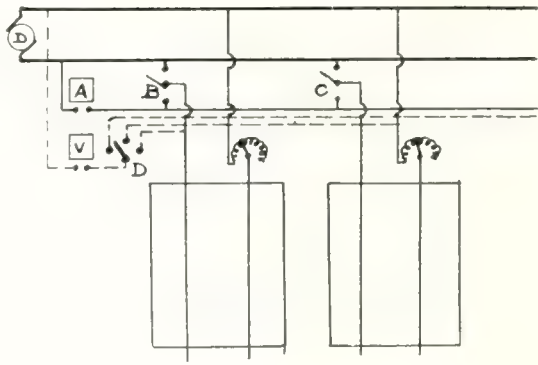


Fig. 18

ammeter. D is the dynamo; the two heavy lines at the top of the figure are the main conductors, which lead off to the tanks as shown. The lighter line next below these two represent a conductor heavy enough to carry the full current from the largest tank. B and C are double-throw switches and A is the ammeter. Referring to the figure, and following the path of the current from the dynamo around through the conductors, rheostats, tanks and back, you will see that when the double-throw switches are in the upper position, the current flows through the tank and back through the lower main con-

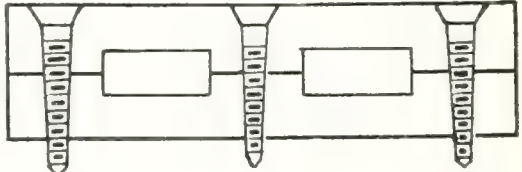


Fig. 19

ductor to the dynamo. If, however, one of these double-throw switches is in the lower position, the current going through the corresponding tank flows back through the third conductor and through the ammeter, where it registers the amount of current that is being taken by that tank. These switches should be ordered according to the amperage each is required to carry.

The dotted lines in the figure show the

ordinary arrangement of wires, for reading the voltages across each tank from one voltmeter. It will be noticed that one of the voltmeter connections goes to the upper main conductor near the dynamo, while for the other connection there is a separate wire going to each tank. Since for voltage readings the size of wire needed is not large, this manner of connection is inexpensive. It has one slight fault, however, namely, that the voltmeter, when so connected, does not register exactly the potential across the tank rods, because of the fact that one of the leads is not connected directly to the tank rod, but indirectly through one of the main busbars. Thus, the reading found is larger than the correct reading by an amount equal to the drop in potential along one conductor from the dynamo to the tank. The difference is small.

In putting up the conductors it is well to see that they are thoroughly insulated. While the voltages used are comparatively small, so that not so much care in insulation is required as on lighting circuits, at the same time the amperages carried are very high and if a short circuit should ever occur, the damage would be considerable; besides which, it is wise also to avoid unnecessary leakages of current. The circular conductors may be carried on porcelain spools, to which they are tied. Fig. 19 shows a form of wooden insulator that may be used for either rectangular or round conductors. The wood should be boiled in paraffine or thoroughly shellacked.

Magnesium

The course of magnesium prices is another unlooked for result of the present war, says the *Engineering and Mining Journal* in a recent issue. In times of peace the price of this metal was about \$1.50 a pound, with a plentiful supply. Partly due to the cutting off of the German exports of the metal; partly due to smaller surplus of magnesium salts, since these were also largely received from Germany; partly due to the tremendously enhanced demand for the metal, the price steadily advanced until in one case \$7.50 per pound was paid for spot metal.

As matters now stand, quotations can be had all the way from \$3.50 to \$6.50, but when one begins to talk delivery under these terms, it is discovered that \$3.50 apparently

secures delivery ninety days after a treaty of peace and \$6.50 secures it at seller's convenience. At the present time it appears that buyers at or around New York could absorb ten to fifteen tons of metal, and that the total spot supplies do not exceed 200 or 300 lb., and these small quantities are being guarded jealously against a day of really high prices.

The Arsenic Problem in Smelting

One of the most deleterious substances in the smoke from many metallurgical plants is arsenic. The important sulphide ores of lead, copper, and other common metals contain appreciable and often considerable proportions of arsenic. In the usual metallurgical treatment of these ores part of the arsenic collects in flues or settling chambers as impure arsenic trioxide, which is subsequently purified by sublimation. The increasing regard in this country for a more complete recovery of this substance arises not only from the necessity of avoiding air pollution in certain regions, but also from the growing interest of the smelting companies in greater recovery and utilization of by-products.

Large Increases in Copper Production

In summarizing the special reports that have come to hand concerning the mining industries of the United States during the past half year, Director Smith of the U. S. Geological Survey observed that the half year just completed has witnessed great changes in the copper industry, and in every particular the improvement has been notable. Copper ore shipments from the Lake Superior mines show an increase of 30 per cent over May, 1914. Prices, output and wages have shown an upward trend, and prosperity is the word in the copper districts of the United States. In Montana the copper mines have about reached normal condition, while the six months' output of copper in New Mexico was probably equal to one-half last year's total output, so there is good expectation of a better total for the year. Arizona shows the usual improvement in copper output during the past six months, and conditions in California have improved; while in Alaska the outlook for increased output is very favorable.

Notes on Mixing and Melting Metals

Discussing the subject of copper alloys recently before the Birmingham branch of the British Foundrymen's Association, H. L. Reason called attention to the endless trouble caused by badly designed melting furnaces and insufficient stacks. He stated that copper alloys should be melted as quickly as possible consistent with avoidance of overheating, as both metal and crucibles deteriorated when kept in the furnace too long. Furnaces should be kept in repair, otherwise more coke was consumed by reason of increased diameter at the melting zone, and in addition a cutting action was set up on the crucibles, as owing to the increased coke space the bottom of the furnace got much hotter than the top. He contended that the tops of the furnaces should not be 10 in. above the floor, as was the common practice in Birmingham; but level with the floor. The speed of melting should be 45 min. for any size pot up to 250 lb. capacity.

In mixing metals, Mr. Reason claimed that a mixture of metals in the same proportions would always yield the same results, in support of which contention he stated that in the case of five test bars cast from different pots of metal no difference was discernible when tested. The alloy consisted of copper 85 per cent.; tin 5 per cent; zinc 8 per cent, and lead 2 per cent. He further stated that the range of copper in gun-metal was from 83 to 85 per cent, and in brasses between 60 and 70 per cent. In the case of brass, increase in zinc added elongation to the copper until the proportion of zinc incorporated reached 30 per cent, and the tensile strength continued to increase until the proportion of zinc amounted to 45 per cent. After these limits was reached, in either case, there was a rapid fall. Curves of the tensile strength and elongation crossed when the zinc content amounted to 40 per cent, hence 60 per cent copper; 40 per cent zinc was the universal mixture for cast brass, but since the elongation was the greatest when the zinc content reached 30 per cent, a mixture consisting of copper 70 per cent, and 30 per cent zinc, was found to be best for drawing tubes and rolling into sheets. In the copper-tin series of alloys, increase in tin caused a corresponding increase in tensile strength and elongation. The tensile

strength rose rapidly until 17.5 per cent tin was reached, but the elongation did not keep pace, as it fell before 10 per cent tin was reached. A mixture of copper 88 per cent; tin 10 per cent and zinc 2 per cent, gave the highest tensile strength with the corresponding best percentage of elongation.

In his opinion it was impossible to tell the quality of a gun-metal by the color, as copper-tin alloys with important variations in their composition were alike in color, and extruded brass a copper-zinc alloy with only 50 to 60 per cent copper had the color of gun-metal. Lead up to 3 per cent could be used in most mixtures with advantage, especially where they had to be machined. Good gun-metal castings could be produced containing from 5 to 7 per cent of lead, but care was required not to overheat the metal in melting. An excellent mixture for thin castings not required to withstand pressures consisted of copper 52 per cent; zinc 41.5 per cent; lead 6 per cent, and aluminum 0.5 per cent. For castings subjected to hydraulic pressure, a very suitable alloy had the following composition: copper, 83 per cent; tin, 5 per cent; zinc, 5 per cent; lead, 5 per cent; and nickel 2 per cent. Such an alloy was better for the purpose than standard gun-metal, as the high freezing point of the nickel trapped the lead and prevented its segregation, producing a satisfactory close-grained alloy. A red brass that would machine well, and cast well, consisted of copper, 83 per cent; zinc, 10.5 per cent; tin 2.5 per cent; lead, 2.5 per cent, and antimony, 1.5 per cent. Another valuable alloy suitable for axle bearings was composed of copper, 85 per cent; tin, 10 per cent; zinc, 2 per cent, and lead 3 per cent.

In the discussion that ensued, F. Johnson advised that caution should be observed in adding tin to yellow brass, because with a metal containing from 60 to 70 per cent copper, the addition of tin considerably reduced the elongation, 0.5 per cent, being sufficient to ruin rolling brass. The difficulty was due to the fact that in the case of brass having that composition there was only one constituent, but if tin was added a second constituent was produced which would not dissolve in the first constituent, but surrounded the crystals in the form of an eutectoid which was detrimental to the physical properties of the alloy.

A SHORT OUTLINE OF THE PRINCIPLES OF CHEMISTRY FOR ELECTROPLATERS—XI

(Continued)

By ALLAN J. FIELD

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Separation of the Groups

Group 3

If it is desired to make up a solution containing the third group, take about a gram of ferric chloride and about an equal amount of aluminum sulphate, then dissolve in water and dilute to 100 c.c. Of this solution 10 to 15 c.c. are taken, add about 30 c.c. of water, and proceed in the following manner:

If instead of taking the above solution, the filtrate from group three is taken, the solution is boiled until all of the H_2S gas is driven out. If this precaution is not taken the fourth group metals will be precipitated with the third group when ammonia is added. A few drops of nitric acid is added to oxidize any iron which may be in the ferrous state, heat to boiling and add about 2 grams of NH_4Cl (which prevents the precipitation of the hydroxides of Mn., Zn. and Ni.), then NH_4OH until alkaline. Continue boiling a minute or two. If a precipitate forms it may be $Fe(OH)_3$ or $Al(OH)_3$ or both. Filter it off and wash with hot water. (The filtrate can be saved and examined for group four.) The precipitate is washed into a beaker with as little water as possible, and add about 15 c.c. of a 5 per cent solution of sodium hydrate, and heat. The $Al(OH)_3$ will be dissolved. Filter off the precipitate. It will be a $Fe(OH)_3$ of a reddish-brown color. It is dissolved in hot dil. HCl ; then add a few drops of potassium ferrocyanide solution. A deep blue precipitate will be produced. The filtrate contains the aluminum as sodium aluminate; acidify with HCl and add NH_4OH till alkaline; a white precipitate of $Al(OH)_3$ will form.

Group 4

The fourth group of metals consists of zinc, nickel and manganese. The sulphates of these metals can be taken to make a so-

lution for the following tests: To about 15 c.c. of this solution add 30 c.c. of water and 4 grams of NH_4Cl , then make alkaline with ammonia and continue as follows:

The ammoniacal filtrate from the third group, or the solution from above, is warmed, then H_2S gas is passed in for about ten minutes, the precipitate allowed to settle, then filtered and washed with hot water containing about 1 per cent of NH_4Cl (the NH_4Cl prevents the MnS and ZnS from changing to colloidal sulphides, which are soluble in water). The precipitate may be ZnS , MnS , NiS . Pour over the precipitates 10 c.c. of a cold 4 per cent solution of HCl (1 c.c. conc. HCl to 9 c.c. of water), receiving it in a test tube, then again pour it over the precipitate, and wash with water containing NH_4Cl . The HCl will dissolve the Zn. and Mn. forming chlorides.

If a black residue remains it will be nickel. Dissolve it in conc. HNO_3 , then evaporate off the excess of acid and barely make it alkaline with ammonia. If much nickel is present a blue coloration will form, as copper gives the same test, and as small amounts of nickel do not give a distinct color, a better test can be had by adding to the barely alkaline solution a few drops of an alcoholic solution of dimethylglyoxine; then warm; a scarlet precipitate will indicate nickel. This is a very delicate test for nickel and will show minute traces.

The HCl solution containing the zinc and manganese is boiled until no odor of H_2S is noticeable (otherwise zinc might be precipitated as sulphide when $NaOH$ is added). It is cooled; then add an excess of sodium hydrate solution. The manganese is precipitated as hydroxide, white at first, which quickly oxidizes by the oxygen of the air to a brown color. The manganese precipitate is filtered off. Sometimes the manganese will be contaminated with zinc so, as a precaution, it is well to pour over the precipitate on the funnel 5 to 10 c.c. of the sodium hydrate solution. The filtrate will contain

the zinc as sodium zincate. It is precipitated with ammonium sulphide as white zinc sulphide.

The following table gives in condensed form the method of separation of the different groups:

Add dilute HCl to the cold solution			
Precipitate:	Filtrate: Pass in H ₂ S gas.		
AgCl PbCl ₂ HgCl	Precipitate: HgS CuS SnS ₂ PbS	Filtrate: Add NH ₄ OH	
		Precipitate: Fe(OH) ₃ Al(OH) ₃	Filtrate: add (NH ₄) ₂ S
	Add NaOH solution	Precipitate:	
	Residue HgS CuS PbS	Solution K ₂ SnO ₃ + K ₂ SnS ₃	NiS ZnS MnS
Group I	Group II	Group III	Group IV

Methods for the Detection of Acids

It is often desirable to know what free acids are in a solution, or what acid radicle is in combination with the metal. The following tests are for the three acids that are generally found in the plating room—sulphuric, nitric and hydrochloric.

To test for sulphuric acid (H₂SO₄) or sulphate radicle (SO₄): Take about 5 c.c. of the solution, add a few drops of HCl, or enough to make it acid if the solution is alkaline, then add about 5 drops of a dilute solution of barium chloride. If sulphuric acid or a sulphate is present a white precipitate of barium sulphate will form. It is necessary that the solution to be tested is acid, as an alkaline solution, such as sodium carbonate, would also give a white precipitate of barium carbonate, which is readily distinguished from barium sulphate, as it is decomposed by HCl.

Nitric acid (HNO₃) or nitrate radicle (NO₃) test:

To 5 c.c. of a cold dilute solution of ferrous sulphate in a test tube, add a few c.c. of the solution to be tested. The test tube is slightly inclined, then add about 5 c.c. of conc. H₂SO₄, letting it run down the side of the tube to the bottom. Care should be taken not to mix the sulphuric acid with the other solution. If a brown ring forms between the two solutions, nitric acid or a nitrate is present. Heat decomposes the brown ring, so it is best to cool off the test tube as soon as the sulphuric acid is added. Another test for nitric acid is the diphenylamine reaction. Place about one-half a gram of diphenylamine upon a watch glass and add enough conc. sulphuric acid to dis-

solve it, a few drops of the solution containing the nitric acid are then added. A blue color will indicate nitric acid.

Hydrochloric acid (HCl) or chloride radicle (Cl) test:

To 5 c.c. of the solution to be tested add a few drops of nitric acid to make it distinctly acid. If litmus paper showed it was neutral or alkaline, then add a few drops of a dilute solution of silver nitrate. A white precipitate of silver chloride will indicate hydrochloric acid or a chloride is present.

Ammonia or its salts can be tested for by adding to the solution a few c.c. of sodium hydrate solution and heating, the odor of ammonia will be given off if it is present.

These directions conclude in a very brief manner how solutions can be tested qualitatively. If the plater has familiarized himself with the different tests, he is now capable of testing a solution for any metal and proving conclusively if it is present or not.

To tell one metal from the other, that is when it is in solution or as a salt, is to recognize certain peculiarities that distinguish it from the others. Qualitative analysis then shows how the peculiarities of each metal can be recognized by means of precipitates with different reagents.

Practical application of qualitative analysis is of course its principal interest to the plater, and it ought to be, considering the opportunities there are in using it in the plating room. The following few examples will indicate a few ways of making use of it:

To test nickel salts for iron:

Take about 10 grams of the salts and dissolve in about 50 c.c. of hot water, then add ammonia until the nickel which is precipitated is redissolved. If a precipitate remains, which on filtering and after washing with water is reddish-brown, then iron is present. It can be dissolved in conc. HCl. Then, if on the addition of potassium ferrocyanide, a blue color forms, iron would be conclusively shown to be present.

To test copper carbonate for sulphates:

Take a few grams of the carbonate, and dissolve in dilute HCl. Then add barium chloride solution. A white precipitate would show that the carbonate has sulphates, which if it was correctly made and washed properly, would not contain any.

To test nitric acid for chlorides:

Nitric acid that is used for dissolving silver should not contain chlorides, as they

form insoluble silver chloride. Take about 5 c.c. of the acid, add about 20 c.c. of water and a few drops of silver nitrate solution. A white precipitate would indicate chlorides.

To test for copper in a nickel solution:

Take about 25 c.c. of the solution, make just acid with conc. HCl, then add 2.5 c.c. more and dilute to 100 c.c. with water. The solution is heated to boiling, then pass in H₂S gas for about ten minutes. If a black precipitate is produced, copper is present. As silver, lead and mercury also give black precipitates, the copper sulphide is dissolved in dilute nitric acid; then add an excess of ammonia. A blue color will result if it is copper.

Spelter Exports Break All Records

Some idea of the magnitude of the demand for spelter by foreign countries is furnished by the report of exports of the metal for the ten months ending with April 30, which amounted to 223,478,162 lb., as compared with 3,243,418 lb. in the corresponding period last year and 4,997,608 lb. two years ago. During the first four months of 1915 exports were as follows: January, 30,597,854 lb.; February, 30,003,018; March, 16,239,953; April, 17,683,173. These compare with the following in 1914: January, 459,703 lb.; February, 35,550; March, 202,000; April, 120,149.

The average price at which spelter was exported during April was 8.9 cents a pound, as compared with 7 cents the preceding month. For the ten months ending April 30 exports and values for the past three years were as follows: 1913, 4,997,680 lb., of a value of \$338,953; 1914, 3,243,418 lb., value \$202,677; 1915, 222,478,162 lb., value \$15,299,343.

During the ten months ending April 30 there was also exported approximately 8,000,000 lb. of "dross" against 572,000 lb. the previous year; also 17,451,565 lb. extracted from foreign material.—*Mining and Engineering World*.

Resistance and Inductance of Iron and Bimetallic Wire

When a direct current flows in a wire, the distribution of the current is uniform over the cross section of the conductor. When,

however, an alternating current flows in a wire, there is a tendency for the current to crowd to the outside. This phenomenon, which is caused by differences in the opposition to the current flow in different parts of the conductor, becomes more pronounced the greater the number of alternations of the current in a given time, and, in iron wires, the greater the current in the wire.

When the conductor is of simple form and the magnetic permeability of the material is known the effective resistance and inductance can be calculated by formulas which have been developed. The results of which have just been published by the Bureau of Standards, in Scientific Paper No. 252. Two classes of conductors were considered in particular—the iron telegraph and telephone wires and copper-clad bimetallic wires. The latter have a core of steel surrounded by a shell of copper. Formulae are developed in this paper which permit a comparison between measured and computed values for the copper-clad wires. The paper concludes with wire tables computed by means of the new formulae. In these tables the effective resistances and inductances of copper-clad wires are given for wires of different sizes and conductivities and for frequencies up to 3000 alternations per second.

Service and Efficiency

THE BRASS WORLD is glad to render service that is efficient. The Racine Aluminum & Brass Foundry Co. writes:

"We wish to inform you that we have overcome the trouble we had with our brass castings recently after following your advice. We assure you the advice is very much appreciated."

The Largest Copper Deposit

The Chile Copper Co. (a Guggenheimer operation) is now in operation, working the largest known copper deposits in the world. Although known to mining engineers the world over for many years, the low-grade deposits of Chuquicamata remained almost neglected. The native Chileans worked various parts of this great deposit in a small way, and for a short while an English company also attempted, unsuccessfully, to work a small part of it.

THE SCHOOP METAL SPRAYING PISTOL*

The "Schoop" metal spraying pistol is the invention of M. U. Schoop, a Swiss engineer, who in the two years that have elapsed since the fundamental patents were issued has effected many improvements in the original apparatus with the result that it now appears to have reached a thoroughly practical stage of development. The spraying device, to a certain extent, resembles a

molten metal. By means of the grip the whole device may be directed to any portion of the object to be treated.

The metal to be sprayed is fed into the pistol in the form of a wire, which in its passage through the pistol is physically unaltered, but on its emergence from the inner tube of the barrel, becomes a stream of metallic particles carried by a current of

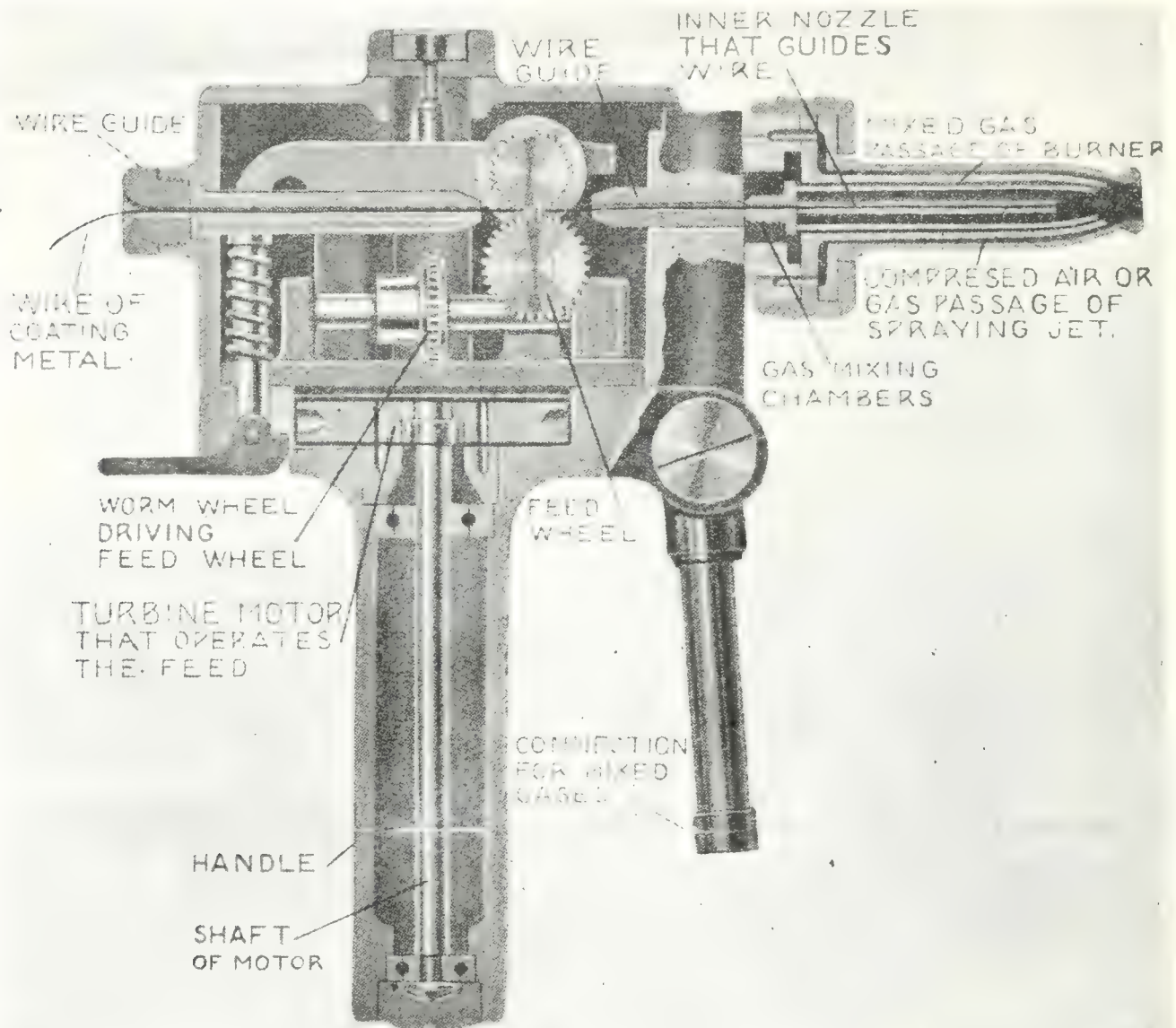


Fig. 1—Section of Metal Spraying Pistol, Showing Mechanism

pistol. It has a grip and a nuzzle but the magazine portion is rather large relatively. The pistol comprises a mechanism that straightens the wire from which the spray is made, feeds it at a speed which may be regulated at will, and concentrates upon the wire the gases that produce the heat that melts, and the spray that is to atomize the

air or gas capable of adhering in the form of a smooth metallic coating upon any subject to which the atomized stream is directed. It is claimed that either metals or alloys may be deposited by this process. Lead, tin, zinc, copper, brass, bronze and German silver having been experimented with. The film that is deposited by the spray may be from 0.001 in. upward, and

* Abstracted from *Scientific American*.

is firm and continuous. While the temperature at the apex of the cone of spray may be from 700 deg. Fahr. to 2000 deg. Fahr., at the distance of only 4 or 5 in., delicate materials that are combustible may be coated with the metal but will not be burned. Matches held in the spray are metallized but not ignited; tissue paper can be surfaced with metal, while brass issuing at 1550 deg. Fahr. has been deposited on silk without injuring its texture. As will be seen by a study of the section of the pistol shown in Fig. 1 there are three concentric barrels, the innermost being the one from which the wire issues. The second tube really constitutes a blowpipe, as by its means the combustible gases under pressure are conducted to the point where the melt-

ments in the barrels, to accord with the varying diameters at which the wires are used, and relative changes are necessary in the air and gas jets. Then there must be the possibility of regulating the feed speed of the wire, which is moved forward by a motor driven by compressed air.

The operation of the spraying device is as follows: The blowpipe performs the duty of melting the wire. The spraying jet has two offices: by its expansion it absorbs heat and keeps the muzzle of the pistol cool, and by its velocity, which may be as high as 3000 ft. a second, it entrains a stream of metal. The metal is in minute particles, either plastic or molten. Some may perhaps be gaseous, surrounded by a protective, reducing atmosphere. This is the cone

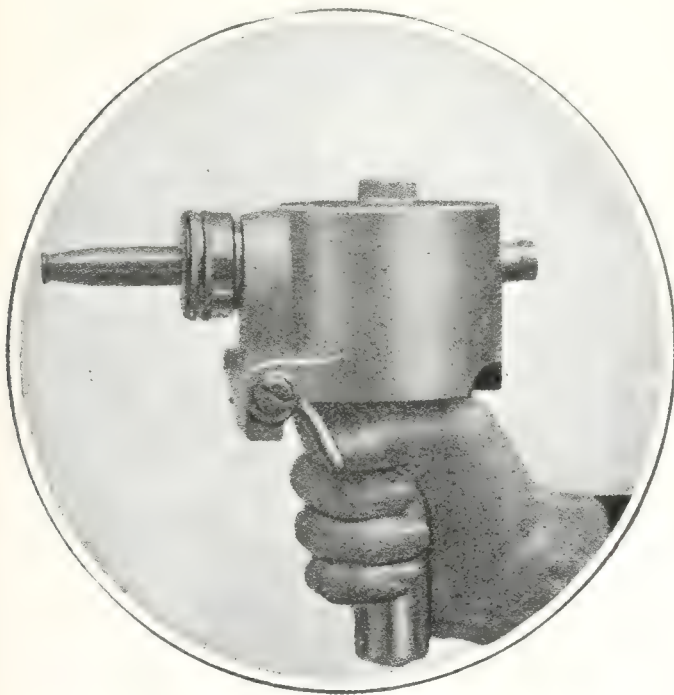


Fig. 2—New Form of Spraying Pistol

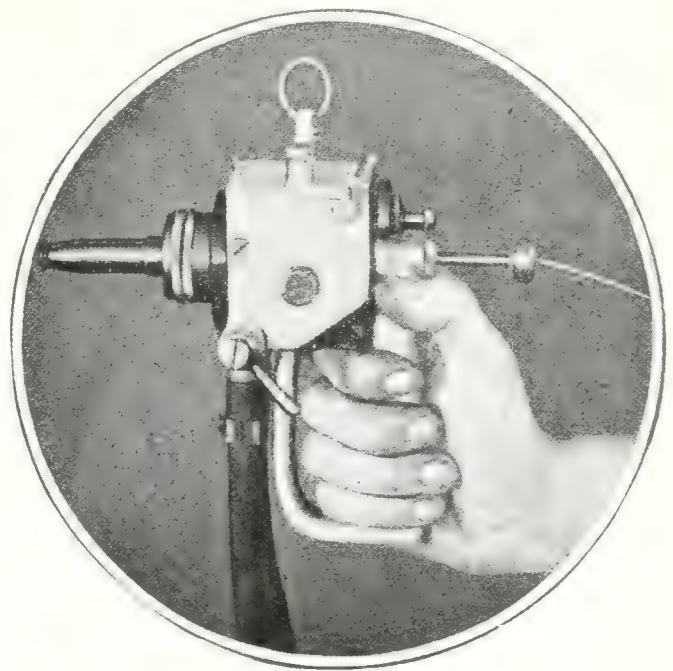


Fig. 3—Old Form of Spraying Pistol

ing is done, and for which purpose they furnish the heat. The outer tube delivers the compressed gas which furnishes the velocity necessary for the spray. The blowpipe mixture in the second tube may be coal gas, water gas, acetylene or hydrogen, with air or oxygen to maintain combustion, while the spraying jet may be carbon dioxide, nitrogen, air or steam. The temperatures, pressures and mixtures differ with different metals, so that accurate gages, reducing valves and the like are portions of the apparatus. Likewise the pressure and velocity of the air jet must be variable to suit the conditions required by the different metals.

There must also be provision for adjust-

which is moving with great velocity toward the object treated. It is suggested that the reason the sprayed metal does not carry sufficient heat to carbonize delicate fabrics is that the spraying medium is enormously greater in volume than the infinitely small particles that it is carrying. It is, moreover, still expanding and absorbing heat, so that, relative to the particles of metal, the cone is cool. But while the cone must deprive the particles of metal of some of their heat, it seems certain from the results that they do not impact upon the object treated in the form of droplets, otherwise they ought to rebound. The assumption is that on account of the heat of the collision the metallic particles pass into a vapor which

at once condenses on the relatively cold receiving body, forming a solid homogeneous mass or film which is hammered and con-

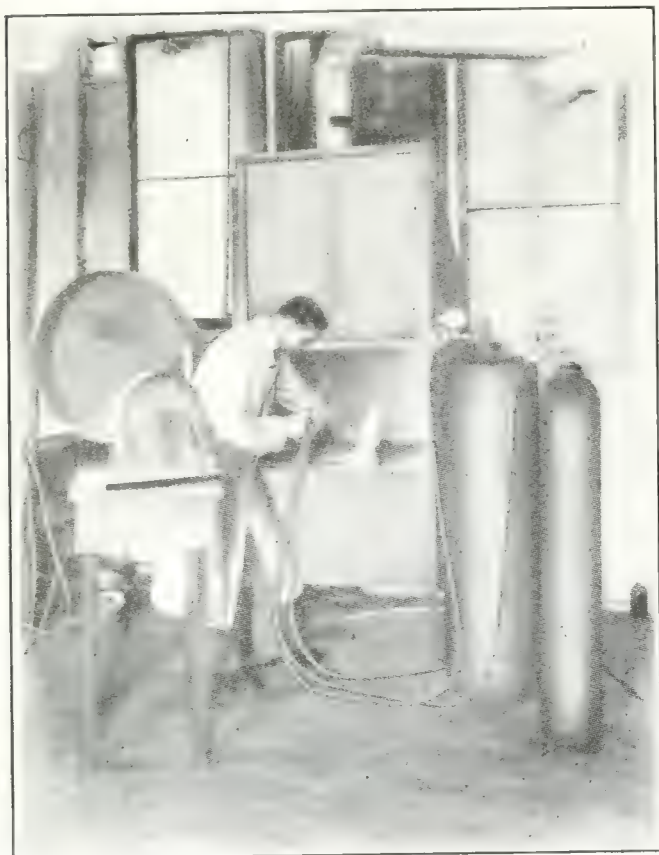


Fig. 4—Example of Method of Operating Pistol

solidated by the velocity of the succeeding particles.

The present form of the Schoop metal spraying pistol is shown in Fig. 2 and the old form in Fig. 3, and the manner in which the pistol is operated at Fig. 4, where a small statuette is being metallized.

A report is current that a company has been organized in Chile to construct works for the smelting of the tin ore of Bolivia at Arica, in the extreme north of Chile. Formerly most of the tin ore of Bolivia reached the coast at Mollendo in Southern Peru, in the form of a "concentrate," and was there put aboard ships and sent to Europe for smelting, since the cost of coal on the Pacific coast of South America had rendered smelting extremely expensive. Much of the coal used on the central and northern Pacific coast has in the past been imported from Australia or England, but the opening of the Panama Canal gives a short route from the coal ports of the United States with the advantage that ships carrying the coal to the smelter can bring back the smelted tin to our market.

Plating From Hot Solutions

By E. S. THOMPSON

Do solutions heated above a temperature required for holding their ingredients in perfect solution, deposit as rapidly, with the same number of amperes per unit, as do those which are worked at a temperature barely sufficient to dissolve the salts added to the solvent?

They do not. In applying Faraday's law to the deposition of metals, we must, in order to figure the number of grams of metal deposited in one ampere hour, make the corrections for gas volumes under the different temperatures and add to the solution a quantity of salt sufficient to raise the specific gravity to the same degree under the higher temperature as that which was shown on the scale at a lower temperature.

It has been suggested by different authorities on electroplating (when answering questions as to how to obtain heavy deposits) that solutions be heated to a certain number of degrees, but no reason that the writer has ever observed has been given for the necessity of raising the temperature.

The writer, without any laboratory equipment, carried on a series of experiments to determine whether a warm nickel solution, saturated with the double sulphates of nickel and ammonium at a temperature of 60 deg. Fahr., would deposit as rapidly with the same number of watts flowing through when heated to 120 deg. Fahr. as it would at the lower temperature. He relied on the readings of the voltmeter and ammeter and the approximate thickness of the deposit when tested on the buff (he had no scales with which to weigh the deposits), and the solution efficiency as well as the current efficiency was greatly in favor of the cold solution, although the deposit from the solution at the higher temperature was more homogeneous and buffed out more brilliantly than that obtained from the cold solution. The time required for a deposit of approximately the same thickness from the two solutions was about one-half less in the cold solution.

The correction for gas volumes was then made according to Charles's law and salt added to the hot solution until the same degree of concentration was reached, and the same number of watts per unit was used, as before. Under the new condition a deposit was formed of approximately the same thickness, and in about the same

length of time, as that formed in the solution at 60 deg. Fahr., the deposit from the solution at 120 deg. Fahr. still maintaining its softness and toughness as well as its higher brilliancy over that obtained from the cold solution.

The next batch was plated with the solution still at 120 deg. Fahr., and the current density raised 50 per cent over the former load. The deposit was obtained in a shorter time and without any objectionable features. Still higher current densities were used at a later date and the time shortened in proportion to the increase in current density, the solution being maintained at 120 deg. Fahr. These experiments were made with both the double and single salt solutions and the results were about the same. Now why?

These observations lead the writer to believe that the electric element does not expand under heat when combined with other elements, and the amount of metal deposited is in proportion only to the amount of hydrogen deposited, which proves the correctness of Faraday's law as regards the deposition of metals in proportion to the amount of hydrogen evolved, but proves the same law incorrect when applied to solutions under different conditions.

That is to say, we could not compute the number of grams of nickel deposited from a solution containing the same percentage of metal and the temperature raised, when the law was based on the reaction of a solution at a lower temperature.

If the electric element expanded in proportion to the gases of the solution under the influence of heat, then precipitation of metal would follow in proportion to the degree of temperature. Since this is not the case, we must rearrange our tables of the deposits in one ampere hour and compute from the coefficient of temperatures, using Faraday's law as a basis, with solutions at a given temperature.

The question may arise as to why the deposit from the warm solution is of a better grade than that obtained from the cold solution. This condition is brought about by the readiness with which the elements re-combine under the influence of heat, thus eliminating the possibility of occluding hydrogen in the deposit, or of oxidizing the oxygen. Then, too, the heat influences the solubility of the metal in its

solvent, bringing it down in a finer state of division. This is demonstrated by adding sulphuric acid to the solution.

Then the deposit will be slow and rather hard under this condition, and if the acid is added in great excess no deposit at all will be formed. But it will be noticed that the deposit is of a finer grain.

This theory may be applied to all solvents used in electroplating.

According to the above, hot solutions are beneficial only when their elements are saturated to the same degree on the hydrometer as those which are used cold, the current efficiency being the same only when the solution reaches the degree of concentration at which it will deposit freely at the lower temperature.

Wave Lengths in the Iron Spectrum

Owing to the increasing demand on the part of chemists for accurate values of the wave lengths of the lines in the spectra of iron and other elements, the Bureau of Standards has taken up the work of determining standards of wave length. This work is being done in accordance with the recommendations of the International Wave Length Committee. The spectrograms were obtained in Marseilles in the laboratories of Buisson and Faby, the pioneers in this work. The plates were measured at the Bureau of Standards.

Method of Estimating Ore Value

In estimating the value of an ore or an intermediate metallurgical product (other than a refined metal) the basis used is the price of the refined metal at some principal market center, such as New York, at the time the valuation is made. The average price of all copper for 1913 was 15.5 cents per pound, and for electrolytic copper 15.269 cents per pound. The prices for other metals for the year 1914 were as follows: Lead, 3.862 cents per pound; spelter, 5.213 cents per pound; silver, 54.811 cents per troy ounce. Gold has the standard value, established by law, of \$20.67 per troy ounce.

If the metal contents, in pounds for the base metals and in troy ounces for the precious metals, per avoirdupois ton be multiplied by the prevailing price of the refined metals, the sum of the products will be the gross value of the ore.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES

Bridgeport—Meets on the third Friday of each month at 260 John Street, Bridgeport, Conn. Secretary Nelson Barnard, 858 Howard Avenue, Bridgeport, Conn.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, S. Wroblewski, 1486 Elmwood Avenue, Buffalo, N. Y.

Chicago—Meets fourth Saturday of each month at 8 P. M. at Western Building, Randolph and Michigan Avenue. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Avenue, Cincinnati, Ohio.

Cleveland—Meets last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Avenue, Cleveland, O.

Dayton—Meets first Wednesday of each month at Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 First Street. Secretary, E. E. Miller, 543 Townsend Avenue, Detroit, Mich.

Indianapolis—Meets last Saturday of each month at the Denison Hotel. Secretary, Arthur Nelson, 1617 Shelby Street, Indianapolis, Ind.

Milwaukee—Meets second Wednesday of each month at Marquette University. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 West Madison Avenue, Irvington, N. J.

New York—Meets fourth Friday of each month at 258-262 Pearl Street, New York City, at 8 P. M. Secretary, Wm. Fischer, 345 East 23d Street, New York.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Rochester—Meets second and fourth Friday of each month at University of Rochester. Secretary, C. V. Haring, 603 Dewey Avenue, Rochester, N. Y.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, F. Rushton, 4405 Blair Street, St. Louis, Mo.

Toledo—Meets every Wednesday at Toledo University. Secretary, James E. Nagle, 209 Navarre Avenue, Toledo, Ohio.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Toronto, Ont.

Society Notes

The Associated Foundry Foremen have given up their charter and all of the members in good standing are now affiliated with the American Foundrymen's Association as associate members. The total number added to the enrollment is 102, thereby increasing the total membership of the society to nearly 1000, the highest mark attained since its organization.

The Atlantic City Convention

Atlantic City is to be the scene of the 1915 meeting of American foundrymen, but this year only two associations whose members are actively engaged in the production of castings will foregather with those who furnish the supplies, instead of three as heretofore, as the Associated Foundry Foremen, the organization founded by Henry Hanson of hallowed memory, has dissolved, and the members have become affiliated as associates with the American Foundrymen's Association.

The annual exhibition of foundry machinery and supplies will be held on Young's Steel Pier, and will be opened Saturday, Sept. 25, and will close Friday, Oct. 1.

The headquarters of the American Institute of Metals will be at the Hotel Traymore, which is only a short distance from Young's Million Dollar Pier, and a hotel will be announced as the headquarters of the American Foundrymen's Association.

The program arranged by the American Institute of Metals includes the reading of the following valuable and instructive papers: "Albany Sand," by D. H. Newland, Assistant State Geologist, New York; "Experience with Brass in Civil Engineering Work," by A. D. Flynn, Board of Water Supply, New York; "Molding Sand," by C. P. Karr, Bureau of Standards; "Aluminum Die Casting Work," by Charles Pack, New York; "Cracking of Wrought Brass from Overstrain," by Dr. Burgess and Dr. Merica, Bureau of Standards, Washington, D. C.; "Manufacture and Use of Aluminum-Vanadium," by William W. Clark; "Some Developments in Aluminum," by C. V. Powell, Toronto; "The Advantage of a Standard Brass Railroad Bearing Alloy," by Russell R. Clarke, Pittsburgh, Pa.; "Silicon Resistance Furnaces for Melting Brass," by Dr. Weintraub; "Effect of Zinc on Copper, Tin, and Lead Alloys," by G. H.

Clamer; "Copper-Aluminum Alloys," by W. M. Corse; "Forging Manganese Bronze," by Jesse L. Jones; "Amorphous State of Metals," by S. L. Hoyt; "Method of Analysis for Complex Alloys," and "Development on Acid Resistance Alloys" (two papers), by S. W. Parr; "Metallographic Examination of 88-10-2 Alloy," by Dr. Rawdon; "Electric Furnaces for Brass Melting," by F. A. J. Fitzgerald; "Cobalt in Non-Ferrous Metals," By H. T. Calmus; "The Electric Furnace for Sherardizing," by Dr. S. Trood; "The Effect of the Present European War on the Metal Industries," by Thomas F. Wettstein; "Stellite," by Elwood Haynes; "Analysis of Babbitt Metal," by Prof. D. J. Demarest, Ohio State University.

Changes in the constitution of the American Institute of Metals, proposed last year at Chicago, have been adopted by the membership at large and include the changing of the dues from \$5 to \$10, the creation of a corporation membership, which enables concerns who wish to render financial aid to the institute to take as many memberships as they wish for their representatives at a reduced rate, thus allowing the foremen and others to attend the meetings and receive copies of the papers. The secretary earnestly hopes that these corporation memberships will be liberally taken advantage of by those who are in a position to do so.

The list we have given of the papers to be presented at the next meeting shows that the educational value of membership in such associations as the Institute of Metals is so great that it becomes difficult to see how anyone interested in such work can afford to be outside of the membership.

The regular monthly meeting of the New York branch of the American Electroplaters' Society was held recently, with President Reama in the chair. After the regular order of business was disposed of Professor Richards of Lehigh University gave an interesting talk on the progress made in electro-chemical analysis, describing the various processes. The next meeting of this branch of the association will be held at the rooms, 258 Pearl Street, on Friday evening, Aug. 27.

The National Association of Brass Manufacturers will meet in Cleveland, Sept. 15

and 16. Reports of members make the average running time of plants 84.52 per cent of normal.

A Rapid Enameling Process

An enameling process, the distinctive feature of which is a quick-drying secured by heating the objects treated in large ovens under a relative high percentage of humidity, has been perfected by the Fickling Enameling Corporation.

After the initial enamel has been applied by either dipping or spraying, the parts are placed in these specially constructed ovens and dried under a uniform temperature and humidity. Thermostatic control keeps the temperature between 110 and 120 deg. F., and water control on a diaphragm regulates the humidity at a point about 40 per cent. of saturation. Where the character of materials allows, the temperature is increased to as much as 200 deg. The final enamel is subjected to a similar baking at a slightly lower temperature. Drying in the ovens under the constant relation of temperature and moisture and the use of water-washed air are said to secure more lasting enamel than is possible by ordinary air drying. Keeping the outer surface green permits the inner layers to dry and set, thus securing a hard and enduring foundation. When dried in the open air the surface becomes hard, while the under coatings may be green for some time. On automobile hoods this results in sweating. Radio method may have wide industrial uses because of the time saved in drying. One oven 19 ft. 6 in. x 42 ft. is in use at present and the method may be efficient with even a larger oven.

The month of June surpassed all previous records in the matter of copper sales, says the *Mining and Engineering World*. It is estimated in the trade that contracts involving over 200,000,000 lb. of copper were entered into during that month, a very large proportion of which was sold at or better than 20 cents. One of the largest producers says that stocks of copper at refinery points are still very low and that production by no means is up to capacity, although of course the output is increasing every month now that smelter material is arriving in larger quantities. The bulk of the heavy copper business in June was for account of American manufacturers having war orders in hand.

The Latest Development in Mechanical Plating Machines

The accompanying illustration shows the new Schulte Mechanical Plater, which has just been placed on the market by the Ele-Kem Company, 1508-10-12 Clybourn Avenue, Chicago, Ill.

This machine is particularly adapted to electroplating small work in quantities, and it is claimed that it shows a large saving in time, labor and expense over other similar devices. The machine is the invention of Mr. Louis Schulte, superintendent of the Ele-Kem Company, and was designed with a view to overcoming the difficulties heretofore experienced by him in using various types of mechanical platers in Eu-

The method of unloading articles from the drum after plating is also extremely simple. The perforated carrier is inserted in place of the lid and with one revolution of the drum is filled. This operation is repeated until all of the finished plated articles are removed, leaving the solution intact in the drum and ready for repeated use.

The construction of the Schulte Mechanical Plater is such as to allow a large amount of anode surface within the drum without interfering with the articles to be plated; doing away entirely with the necessity of perforations and making it possible to plate the smallest articles, such as needles, pins, screws, rivets, etc. The drum in revolving clockwise subjects the articles

thoroughly to the action of the electric current, resulting in a perfectly uniform plating.

In this machine two-thirds of the drum is immersed in the solution and it revolves in the tank without the necessity of center shafts, bearings, etc., but by the use of two rings suspended and traveling on rollers; one ring acting as a gear and the other as an electrical connection for the current.

The Schulte Mechanical Plater is substantially constructed of 2-in. cypress. The standard size barrel is 36 in. in diameter and 12 in. wide, resting in a tank 53 in. long, 21 in. wide and 33 in. deep (inside measurements).

Another important feature of this machine is that the standard size machine is so constructed as to allow the adjustment of five anodes within the barrel, each 10 x 10 in. of any gage, suspended from copper bars without interfering with the work and giving a total anode surface of one thousand (1000) square inches.

The Ele-Kem Company has just issued a folder describing the Schulte Mechanical Plater, which will be sent to all interested parties on application.



Schulte Mechanical Plater

ropean countries, as well as in the United States, during the past twenty-four years. It therefore represents the latest improved form of mechanical plating device and combines a number of features to be found in no other machine or apparatus. Among the leading features which will appeal to the practical electroplater is the method of loading and unloading the contents of the barrel. In loading the lid is removed from the drum and the articles are loaded as shown in the illustration, without removing the drum from the solution or disconnecting same from the plating current.

◆
"Keep your eye on *The Brass World*."

QUESTIONS AND ANSWERS

All communications under this head should be addressed to the "Questions and Answers Editor"

QUESTION No. 65.—We have a plating and finishing department where we electroplate in copper, nickel, brass and zinc, and also finish brass in different ways. We get a good deal of work on gas and electric fixtures, and these are mostly wanted in old brass, also called dull brass finish. We produce this finish on brass goods by scratch, brushing before lacquering. We regularly finish some of our regular goods, including letters and fixtures, in this manner, and inclose herewith a figure 8 so finished.

We make steel chandelier chain to be used in connection with the fixtures referred to above, and have trouble in plating it to match the old brass fixtures. The enclosed figure shows the color we want, but our efforts to get by plating and lacquering a color to match this on our chain, so far have been unsuccessful. If you can tell us what is necessary in order to get the required color by plating, we shall esteem it as a great favor. The chain we refer to is made of No. 7 steel wire, with straight links 2 in. long. We can polish it before plating as bright as a mirror.

ANSWER.—While you do not say whether your color is too light or too dark we assume that your trouble is in not getting a proper shade at the start. We would suggest that you first give the chain a coating in cyanide copper solution and then in order to obtain the necessary thickness deposit copper from an acid copper solution. Then give the brass coating, scratch, brush or sand blast and lacquer as usual.

Gold Plating Only

QUESTION No. 66.—If you will instruct me how to plate some metals without using a gold solution—anything that would not be expensive—I would be greatly obliged.

Under separate cover I am inclosing a metal showing the desired color. This must not be expensive as the work will not stand it. Kindly make instructions plain,

as I have not had much experience in the plating line.

ANSWER.—The sample you submit has been gold plated, and you cannot match the color exactly, without plating with gold. The following formula will give you the desired results:

Water	1 gal.
Cyanide	10 oz.
Chloride of gold.....	10 dwt.

Casting Trolley Wheels

QUESTION No. 67.—Can you give me the latest mixture that is being used in the casting of trolley wheels?

ANSWER.—Trolley wheel mixtures are liable to variation. The wheel must not be so hard that it will cut the wire, nor so soft that the flanges will batter over when the wheel jumps and strikes a span wire. The metal must also cast well. The following alloy will meet these requirements:

Copper	93.50 per cent.
Tin	6.00 per cent.
15 per cent Phosphor-copper..	0.50 per cent.

Imitation of Platinum Black

QUESTION No. 68.—Please inform me what can be used to produce a black coating on silver. Have been informed that platinic chloride will produce it, but wish to secure something cheaper.

ANSWER.—A good imitation of platinum black is made as follows: Dissolve iron filings in muriatic acid until the acid will dissolve no more, then measure the clear acid in a glass graduate and pour it into a large jar. Measure out the same amount of nitric acid and add to the iron solution. After two or three minutes the united acids will start to boil, then as suddenly fall flat and cool off. After the solution has cooled it can be applied with a brush, or used as a dip. For a cheap black use four ounces of liver of sulphur dissolved in hot water.

Browning Steel

QUESTION No. 69.—I should esteem it a favor if you would tell me one or two ways of browning steel, etc.

ANSWER.—Architectural steel is colored brown by dipping or washing with a solution containing—

Water 1 gal.

Sulphate of copper..... 8 oz.

Sulphuric acid 1 oz.

After the steel has been covered with a film of copper it is heated in an oven, or over a gas burner until the shade of brown desired is obtained. Finish with a soft brass wire brush, or rub with burlap dipped in turpentine. If it is not feasible to heat the articles, rubbing the copper film with antimony sulphide will give pleasing browns. Gun barrels, machinery parts, etc., are colored by subjecting the steel to the fumes of muriatic acid, then rubbing with thin oil and crocus.

To Prevent Pitting

QUESTION No. 70.—We are sending you under separate cover a razor blade which is pretty badly pitted in the nickel solution. We are having this trouble from time to time, and do not know what causes it. We are stringing four dozen razors on a wire and the pitting shows only on the first three or four blades on the outside. We would very much appreciate it, if you would give us a remedy to overcome this.

ANSWER.—The pits on the razor blade are caused by the hydrogen that is liberated in the nickel bath, forming small bubbles that cling to the surface. There is nothing that can be added to the solution to prevent pitting, the only remedy being to remove the bubbles by mechanical means. A simple method of removing them is to strike the cathode (work) rod a smart tap with a mallet every fifteen minutes during plating. The sudden jar breaks the bubbles, and the released gas rises to the surface and escapes.

Plating on Aluminum

QUESTION No. 71.—I want to know how to plate nickel on polished aluminum ware, and anything you can tell me about it will be greatly appreciated.

ANSWER.—Although there are several formulas for plating aluminum, there is no process known that is reliable or practical enough to use commercially.

Plating Nickel on Steel

QUESTION No. 72.—Can you give me a reliable formula for a nickel solution that will plate a nickel on knives and scissors that will stick. I see the shear manufacturers plate in nickel and grind right over the plating to sharpen and the plating sticks. My nickel solution work is O. K. on almost all work, but I have some knives to plate in nickel, and it won't stick to the cutting edge but for a day or two, and then peels back from it. On dental instruments it worked nicely, but on the knives it doesn't.

ANSWER.—The peeling back from the edges is caused by too high voltage or too acid solution. If litmus paper shows too high acid content, add carbonate of ammonia until the solution stands practically neutral. The standard solution for skates, edge tools, etc., is as follows:

Water 1 gal.

Double nickel salts.....12 oz.

Single nickel salts..... 2 oz.

Carbonate of ammonia, 1 oz. per 100 gal. solution.

Coating to Form Terne Plate

QUESTION No. 74.—Please describe terne coating on sheet iron. We understand that it is lead and tin and would like to know the proportion used, and what flux is necessary to attach same by the hot process to sheet iron, wire, etc.

ANSWER.—The alloy used for coating iron to form terne plate consists of lead and tin in varying proportions, the most common mixture being tin 27 per cent, lead 73 per cent. Before immersion in the molten terne mixture the plates have to be thoroughly cleaned by acids in a manner similar to that practised in galvanizing and ordinary tinning operations. The terne plates are furnished in sheets 20 x 28 in., 112 sheets to the box, and also in the form of roll roofing.

Wants Good Green-Gold Formula

QUESTION No. 76.—Please give me a good and bright green-gold formula. I have had no success, so far.

ANSWER.—Make a cyanide solution, using 4 oz. of C. P. cyanide of potassium per gallon. Run in four dwts. of green-gold per gallon, and allow the solution to cool. For deep green, use 19.5 K anodes; for the light green use 18 K.

For bright green the solution is used cold, with a very high voltage.

How to Produce "Silverine" Finish

QUESTION No. 77.—I am sending samples of steel pen points holding a finish called "silverine." One point has been acid dipped and shows a heavy copper coat. The outside coating of points is tin. We cannot duplicate the bright finish.

ANSWER.—To finish steel pens like sample, treat as follows: Tumble the pens in scap solution with steel balls until bright, then copper-plate in a hot strong copper so as to obtain a heavy bright deposit. Dip in hot tin, using plenty of tallow to keep it covered. They should come out clear and bright, but can be finished by running in the tumbling barrel, using molasses instead of soap in the water. Sample pens have not been acid dipped.

Not a Good Formula

QUESTION No. 78.—A recent issue contained this formula: Water, 1 gal.; double nickel salts, 8 oz.; single salts, 1 oz.; sal ammoniac, 1 oz.; boracic acid, 6 oz. We made up the solution, 6 deg. Baumé, which gave good silvery deposit on the first run, but subsequent work has been unsatisfactory.

ANSWER.—The nickel solution can never be made to work in a satisfactory manner. The cheapest thing to do is to make a new one. A more satisfactory nickel solution than the one given consists of:

- Double nickel salts.....10 oz.
- Sulphate of nickel..... 2 oz.
- Epsom salts 6 oz.

Dissolve the salts in the solution in the order given.

Making Brass Cylinder by Electrolytic Process

QUESTION No. 80.—We would like to have some information relating to the operation of making a brass cylinder about 4 or 5 in. in diameter by the electrolytic process. The composition of the cylinder would have to be approximately two parts of copper and one of zinc. Could you advise us as to the solution used for this purpose? Is there a book published that would give us this information?

ANSWER.—It is impossible to deposit brass in an acid solution, and as the wax or gutta-percha molds would be destroyed

in the alkaline ones, the only way you can make the cylinder by the electrolytic process is to make shells in an acid copper and finish with a brass face. The acid copper is made by dissolving sulphate of copper in warm water until the solution stands at 18 deg. Baumé, then add 2 oz. of C. P. sulphuric acid and 1 oz. of common molasses, per gallon. The brass solution should contain:

- Water 1 gal.
- Cyanide of potash..... 8 oz.
- Cyanide of copper..... 4 oz.
- Cyanide of zinc..... 2 oz.

Aqua ammonia until bright brass color is obtained.

The acid copper and the brass are usually worked at about 80 deg. Fahr. *Electrotyping*, by C. S. Partridge, contains up-to-date information on the subject. This office can supply it.

Tubbing Solution

QUESTION No. 81.—I use a tumbling barrel with steel bullets on brass and small copper pieces. Please let me know what kind of solution to use. My barrel runs 13 r.p.m.

ANSWER.—About 2 oz. of fig or castile soap per gallon is the usual tubbing solution. The barrels are usually run from 30 to 46 r.p.m.

For a Bright Finish

QUESTION No. 82.—Please give us the formula for obtaining a bright brass finish on steel shells, said dip to be such that it can be used on medium plated work; also the best method for drying this after having dipped same for bright brass finish. We are now having considerable trouble with the material because, after having been dipped in hot water, it shows streaks, or so-called water marks. We also wish to inform you that after dipping in hot water we finish drying by applying hot sawdust, and still the material shows these streaks.

ANSWER.—If the shells are of such nature that they can be tumbled in a burnishing barrel with steel balls, that would be the best and cheapest method of brightening them. The regular acid consists of:

- Oil of vitriol, 1 gal.
- Nitric acid, 1 gal.
- About 2 oz. common salt dissolved in ½ pint of water.

Allow the dip to cool before using. After the articles are dipped in the acid, they must be rinsed in cold water, then dipped in a weak cyanide dip (30 oz. per gal.), dipped in a soap solution made by using 2 oz. fig soap per gallon, then dipped in hot water and dried as usual.

Duralumin

QUESTION No. 87.—Kindly inform me where I could obtain some of the metal duralumin. I believe this metal is used in making Maxim guns.

ANSWER.—It is possible that samples of the metal duralumin could be obtained from dealers in aluminum and its alloys, the addresses being obtainable from the advertising columns. The composition of this alloy is as follows by analysis: Copper, 3.85 per cent; iron, 0.62 per cent; magnesium, 0.75 per cent; manganese, 0.10 per cent; aluminum, 94.25 per cent. The alloy might be used for parts of guns provided they were small and unimportant.

Casting Copper Rings

QUESTION No. 89.—We would like to know whether we can use an iron mold for casting copper rings 3/16 in. thick, 7/8 in. wide and 3 in. in diameter. We would like to make about twelve of these rings in one mold, and wish to know whether they would come solid. We would also like to be informed whether we could use copper turnings in making these rings and get sound castings in the iron molds.

ANSWER.—We doubt whether it would pay to use iron molds for these rings even if they were cast in the form of bushings and cut into rings afterwards, as a core would have to be inserted in the center for the metal to crush as it contracted, otherwise the ring would be ruptured. Casting a copper bushing and machining off the rings is the only practical way in which they could be made in chills, for a ring 3/16 in. thick would never run in an iron mold. Both anodes and electric furnace contacts are cast successfully in iron molds, but it is necessary to use a deoxidizer in copper so cast, otherwise the castings are not solid, although more so than if cast in sand molds. A 10 per cent silicon copper is effective as a deoxidizer for copper castings. It should be used in the proportion of 0.5 per cent for chill castings and 0.75 per cent in the case of sand castings. Copper turnings are

not good stock for making copper castings, as they expose a relatively large surface to oxidation, and are more liable to make spongy castings than massive copper.

Trade Publications

In reviewing the sixth edition of H. W. Macklin's work entitled "Monumental Brasses," *The Ironmonger* of London, Eng., makes the following interesting remarks: "The Church in bygone days provided many opportunities for metalworkers, for bell-founders, ecclesiastical smiths, and plumbers, who supplied lead for roofs and gargoyles and, to a smaller degree, for fonts. The crafts mentioned, as well as the use of brass for decorative and monumental purposes, have all received attention from antiquarians interested in one or the other metal, but hitherto, as far as we know, no one has given us a comprehensive survey of ecclesiastical metalwork. If such a book should come to be written it is not unlikely that Mr. Macklin will be laid under contribution for one phase of it. With regard to the material used for monumental brasses, the author tells us that the sheets were commonly known as cullen plates. The material was really a variety of latten brass, and took its name from Cologne, where, up to the middle of the sixteenth century, it was manufactured. A dated example (1504), now in the South Kensington Museum, was analysed and found to contain copper 64 per cent, zinc 29 per cent, lead 3½ per cent, and tin 3 per cent. A still earlier example contained no lead and only a trace of tin, the proportions of copper and zinc being relatively high. The metal possesses a considerable degree of hardness, which probably accounts for the life of these monuments; indeed, there are plenty of records of churches having been burnt down without the brasses being damaged past restoration. Mr. Macklin furnishes some interesting details regarding the engraving and the method of fixing the plates in the matrices cut in the stone. His notes on heel-ball rubbings will also be appreciated by those who follow the subject for its historical interest. It is a matter for regret that from the time of the Commonwealth war down to the end of the eighteenth century brasses were held with scant respect. The alloy, as such, often had a fancy value, such as copper has in Germany at present, and plenty of it was re-

moved by iconoclasts or appropriated by workmen engaged on restoration work. The thieves did not scruple to convert it into ready money, and the brasses in their turn were turned into cannon and later put to industrial purposes. It is pleasant to learn that some were set aside or put to household uses, and that during the nineteenth century not a few of these were recovered and were fixed back in their original positions."

THE JOURNAL OF THE INSTITUTE OF METALS.

(Vol. XIII.) Edited by G. Shaw Scott, M.Sc. Published by the Institute of Metals, Caxton House, London, England. Price 21 shillings.

Though published in the midst of the world's greatest war the present *Journal*, the thirteenth of a half-yearly series, is one of the largest and most important that have been issued by the Institute of Metals. It contains 471 pages, as well as 10 full page plates and numerous illustrations in the text. For the most part the volume is a record of the papers read at the recent London meeting of the Institute, and of the discussion that took place then, and subsequently by correspondence, on these papers. In addition, there is a communication on "Bronzing Processes Suitable for Brass and Copper," which was read before the Birmingham section of the Institute. The section of the book containing international abstracts of scientific and practical papers dealing with copper, brass and other non-ferrous metals is remarkably complete, bearing in mind the difficulty of obtaining access to Continental technical and scientific papers.

A new booklet entitled "The Modern Method of Cleansing Metal Surfaces" has just been issued by James H. Rhodes & Company of Chicago and New York. This is quite a comprehensive pamphlet on the subject of cleansing metal surfaces and it shows the advantages of Carlsruhe Cleanser for this purpose. Complete instructions for cleaning various kinds of work are included, as well as a good deal of general information on this subject which will be of interest to platers. Copies of the booklet will be sent on application to James H. Rhodes & Company, 162 W. Kinzie Street, Chicago, or 162 William Street, New York City.

"The Coking of Coal at Low Temperatures with Special Reference to the Properties and Composition of the Products," by S. W. Parr and H. L. Olin, has been issued as Bulletin No. 79 of the Engineering Experiment Station of the University of Illinois. This bulletin presents the results of a series of studies made in continuation of the work described in Bulletin No. 60. Coke resulting from the low temperature process retains no tar-forming constituents and may be used successfully in the suction gas-producer. It is likewise adapted to use in domestic appliances when absence of smoke and soot is desirable. The tar has an abnormally high content of tar acids (30 per cent) and promises, therefore, to be of value to the wood preservation industry. Copies of Bulletin No. 79 may be obtained gratis upon application to C. R. Richards, Acting Director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

"Chemical German." By Prof. F. C. Phillips, University of Pittsburgh. Pp. 252. Price \$2. May be had at this office.

Four bulletins have just been received from the Mott Sand Blast Co., illustrating and describing the extensive line of sand blast machines and accessories manufactured by this firm. The first of these describes the Mott direct pressure sand blast machine (hose type)—the second describes the Mott sand blast tumbling barrel (type P. V. D. double)—the third the Type G. sand blast tumbling barrel with revolving table and cabinet and the fourth the line of Mott sand blast accessories.

Copies of any or all of these bulletins can be secured from the Mott Sand Blast Manufacturing Co., 24 S. Clinton St., Chicago, or 1157 E. 138th St., New York.

Further Advances in Tungsten

Advices from England are that, owing to the increasing demand and the continuing shortage of tungsten ore, the price of ferro-tungsten in the latter part of May had advanced at Sheffield to \$1.34 per pound of contained tungsten, while the powdered metal was \$1.46 per pound. It is reported that the price in this country has now reached \$2 per pound as against \$1.50 to \$1.60 a short time ago.

Trade Notes

Tailorsville (Ill.) Electroplating Co. has begun business as nickel and silver platers. James and Melvin Young, proprietors.

The Aluminum Co. of America at its Massena (N. Y.) plant has been having labor troubles and strike experiences, troops, etc. More pay was refused and about a thousand began to start something. Leaders were arrested.

The plant of the United States Metal Products Company at College Point, L. I., N. Y. City, and which is valued at approximately \$1,000,000, may be purchased by capitalists who contemplate the manufacture of war ammunition.

The Corbin Screw Corporation, New Britain, Conn., is now at work on a \$90,000 order for shrapnel shell parts for the Russian Government under a sublet contract. The factories of North & Judd Mfg. Co. are also participating in the shrapnel shell parts orders now being let out.

Another concern which is profiting by the heavy war orders is the Traut & Hine Mfg. Company. That concern has received no less than three successive orders through J. P. Morgan & Company calling for over 120,000 gross brass fasteners for the leggings of British soldiers.

George G. McMurtry, chairman of the American Sheet & Tin Plate Company, a subsidiary of the United States Steel Corporation, died suddenly at Atlantic City Aug. 6 in his seventy-ninth year. He had been ill for two months. Mr. McMurtry was much averse to publicity, and was said to be one of the 500 New York millionaires whose names were never seen in print.

The Republic Metal Ware Co. of Buffalo, N. Y., is in the position of refusing an 80 million (?) order for cartridges. Reason: High moral business standards, according to their statement.

H. Edelman has purchased the Middletown (Ohio) Sheet Metal Works from W. Elters and J. Sweeney.

Work on what is said to be the largest tin mill in the world has been started at the Port Vue plant of the McKeesport (Pa.) Tinsplate Co. There are 22 mills, but it is planned to add 20 more. President E. R. Crawford says that the new plant will be ready to begin operations next April.

E. B. Alling, who has been associated with E. F. Neumann in the metal pattern-making business for the past four years at New Britain, Conn., has retired from the firm.

The New York and Hagerstown (Md.) Metal Stamping Co. plant, formerly the Pope Automobile Works, is working on stamping brass for shells. It has a large contract.

The Delaware Seamless Tube Company, Auburn, Pa., has a \$100,000 contract from the British Government. Work on the tubing has already been started at Auburn.

United Welding & Mfg. Co., New York, has been incorporated at \$5,000. J. Kohrman, C. Giacomarra and E. S. Foster are the incorporators.

Federal Enamel & Stamping Co., McKees Rocks, Pa., increased capital stock to \$187,500.

United States Stamping Co. and Wheeling (W. Va.) Metal Mfg. Co. have both resumed work after having been shut down.

William C. Squier, son of father of same initials, and both in life, for fifty years interested in New Jersey Zinc Works, died in Rahway, N. J., July 8.

Louis T. Bennett died July 2 at his late home in Chicago. Death came after a short illness. Mr. Bennett was connected with The Ohio Brass Company at one time.

The Metal Toy Mfg. Co. has been incorporated in New York City at \$25,000 by E. Ropaschinski, L. Schlaeppli and R. I. Willmath.

The Coe Brass Works, Torrington, Conn., are building a million-dollar plant extension.

The Hewitt Bearing Metal Company of Newark, N. J., manufacturer of brass and bronze castings, whose plant was recently destroyed by fire, is erecting a new fireproof foundry. The plant when completed will not only be double in capacity, but will also be equipped to the point of perfection of efficiency.

The DeVilbiss Mfg. Company, Toledo, Ohio, will erect a factory at Walkerville, Ont., of brick and concrete construction, to cost \$30,000. Construction work will be started about Sept. 1. It manufactures atomizers, etc.

The Cleveland White Metal Company, Cleveland, recently organized, will erect a two-story plant, 50 by 150 ft., on Grant Avenue.

The Bridgeport Brass Company, Bridgeport, Conn., has plans for a one-story brick addition to its present casting building on Grand Street to cost about \$70,000. It will increase the daily capacity of the plant about 100,000 lb., and will give employment to about 100 more men. W. R. Webster is superintendent.

The Prest-O-Lite Company, Indianapolis, Ind., has awarded contract for the construction of a factory in East Omaha, Neb., to cost about \$10,000.

The Buffalo Copper & Brass Rolling Mill Company has let contracts covering two shop buildings, 250 by 600 ft., and 250 by 400 ft., respectively, and a brick and steel laboratory building to be added to its plant at the New York Central Railroad, Denver and Ansteth Streets and the Military Road, Buffalo.

The National Enameling & Stamping Company, 1901 Light Street, Baltimore, expects to receive a contract to furnish the British Government a large number of field kitchens. William H. Matthai is manager.

The Dirigold & Metals Co. has purchased the plant formerly owned by the Renziehausen Co. in Newark, N. J., from the Heer-Scofield Co., which purchased the plant at the time the Renziehausen Co. went into bankruptcy. This company is the maker of the metal known as Cupror, and also finishes products of flatware, which is designated Dirigold.

The Krowen Mfg. Co., manufacturer of jewelry, has started in business in Newark, N. J.

J. J. Buchey & Co., Philadelphia, were sustained in the contention that aluminum spoons, entered under the present tariff are properly dutiable at 20 per cent ad valorem as "manufactures of metal not specially provided for." The Collector was reversed in his return at 25 per cent as "table utensils composed of aluminum."

The quantity of aluminum consumed in the United States in 1914 was 79,129,000 lb., against 72,379,000 lb. in 1913 and 65,607,000 lb. in 1912.

The Solar Metal Products Co., Columbus, Ohio, with a new \$50,000 plant, has commenced manufacturing.

The Buckley Welding Co., Waterbury, Conn., is now ready to begin operations. Postmaster Edward M. O'Brien is president, William A. Buckley is secretary and

treasurer, and these two, with T. F. Hayes, constitute the board of directors. The capital stock is \$2,025.

Fire Prevention Specialties Co., fire protection, equipment, plumbers' brass specialties, \$5,000; C. F. Mulgrew, J. J. Whalen, W. R. Gough, 5 Cortlandt Street, New York City.

The National Enameling & Stamping Co. has contracted to manufacture a huge quantity of utensils which go to make up soldiers' kits, such as cups, knives, forks and canteens.

The International Silver Co., Lyons, N. Y., will build a new one-story silverware factory to employ 200 hands. Operations begin in the fall.

Johnson, Sharp & Co. have a Delaware charter to deal in iron and other metals. Stock \$50,000, and incorporators Wilmington, Del., men.

The Chattanooga (Tenn.) Stamping & Enameling Co., of which William Lipphardt is manager, has commenced operation. The plant is located at Moccasin Bend, and is employing between 75 and 100 men. Materials for a complete output have not yet arrived. The furnaces, however, are running, and it will be only a few days before the new industry is operating to capacity.

Abbott Stamping Co., Detroit, has been incorporated to make steel stampings and enamelings.

Representatives of the Canadian Cobalt Co. of Delord, Ont., Canada, gave a demonstration of the new process of nickel plating which is interesting the nickel plating industry, at the Engman-Matthews Range Co., South Bend, Ind.

Dayton (Ohio) Enameling Co. has been incorporated. Capital \$1,000. R. L. Marquis, R. I. Keller and B. Worman.

Exportation of tin refuse from Britain is now prohibited because the Germans might recover the tin and send the iron to Krupp.

The New Jersey Iron & Metal Co., Newark, has been incorporated to buy and sell metal junk of all kinds. The concern has power to issue \$50,000 capital, but is starting with \$1,000. A. Kaplan is the agent at 25 Mulberry Street.

"Trade Opportunities" appear on page 328 this month. Usual position next month.

CLASSIFIED ADVERTISEMENTS

Advertisements for Situations Wanted published free of charge for subscribers. Help Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars.

Help Wanted

WANTED—Good capable man to take charge of plating, polishing, buffing and lacquering department in large electrical concern in Middle West. Give references and state experience. Address Box 13, BRASS WORLD, Edison Bldg., New York.

WANTED—Chemist, experienced in conducting chemical and physical tests of steel. Man with experience in electrolytic chemistry preferred. State references and salary expected. Address Box 10, BRASS WORLD, Edison Bldg., New York.

SALESMAN wanted by concern making a superior line of supplies for metal finishers. Must be acquainted with the trade. Commission basis only. Liberal inducements to the right man. Address Box 3, BRASS WORLD, Edison Bldg., New York.

FOREMAN PLATER—Competent man who can take charge of room. Must be A1 on both flat and Britannia Metal Hollow-Ware. Give references and salary required with application. Address Box 8, BRASS WORLD, Edison Bldg., New York.

PLATER—To take charge of plating room. Must be familiar with work in copper, brass, nickel, etc., but experience in gold, silver, etc., not necessary. Address Box 17, Brass World, Edison Bldg., New York.

Situations Wanted

PLATER—First-class; steady. Can mix and run all solutions, barrel and still plating. Ball burnishing, etc. Desires to change. Moderate salary. Address Box 11, BRASS WORLD, Edison Bldg., New York.

PRACTICAL PLATER—Fourteen years' experience; all finishes in gold, silver, nickel, copper, brass, bronze, oxidizing, etc. Can make all solutions. Have had wide experience making various kinds of goods. Steady and sober; quick worker. Please give some details as to nature of work, solutions, etc., if out of town. References. Address Box 5, BRASS WORLD, Edison Bldg., New York.

PRACTICAL MAN—Understanding plating, polishing, buffing. Over 20 years' experience. Wants place as superintendent or foreman of departments named in a manufacturing plant. Best references. At present engaged, but desire to change. Address Box 12, BRASS WORLD, Edison Bldg., New York.

EXPERT PLATER—Nickel, copper, brass and zinc plating. Seventeen years' experience. Assure best work, and at a great saving. Address Box 1, BRASS WORLD, Edison Bldg., New York.

FOREMAN ELECTRO PLATER—Well known in the trade, is desirous of connecting with a reliable concern. Have had a broad experience on a large variety of work, in gold, silver, nickel, black nickel, copper, brass, bronze and zinc plating, on silverware, bicycles, stoves, saddlery hardware, typewriters, builders' hardware and all kinds of brass goods. Thoroughly understand all solutions and the production of all finishes, both standard and special. Capable of handling large departments, including polishing, buffing, burnishing, lacquering and etching. Sand tumbling, barrel polishing and ball burnishing. Barrel plating of all kinds. Modern methods for economical production. Address Box 2, care BRASS WORLD, Edison Bldg., New York.

FOREMAN PLATER—Experienced in various lines; bright copper, brass and nickel solution a specialty; wide experience on mechanical plating machines. All references. Will accept position anywhere in U. S. Address, Box 7, Brass World, Edison Building, New York.

POLISHER, BUFFER AND PLATER—First class as all three. Want to make change. Prefer Chicago, New York or its suburbs. Address "CAPABLE," care Brass World, Edison Bldg., New York.

PLATER, POLISHER and BUFFER—Wide experience, desires position where executive ability is required. Have made and used all known solutions on any line of work. Installing plants, and introducing efficient systems for day or piece work a specialty. Address "Experience," care Brass World, Edison Bldg., New York.

FOREMAN PLATER—18 years' experience as practical, all-around man. Can make and take care of all solutions, also make all dips, stains, and bronze finishes of any shade. Toning of metals to match sample of any color. Experienced on lighting fixtures, lamps, trunk hardware, hollow ware and architectural bronze work. Position in Greater New York preferred. Address "PRACTICAL PLATER," care Brass World, Edison Bldg., New York.

POLISHING—This one thing I know. Have made many labor-saving devices, reducing cost over one-half, at same time doing better work. Are used in present position. Twenty years spent in studying and producing results. High references. Address "POLISHER," care Brass World, Edison Bldg., New York.

FOREMAN PLATER—Experienced man can take charge of polishing and buffing; has good reference from last place, where I had charge of the plating department in fancy brass goods. Experienced on such goods as chafing dishes, percolators and electro tin, also silver plating. Address Box 4, care Brass World, Edison Bldg., New York.

PLATER—Understands plating, polishing, buffing, lacquering, oxidizing, satin finish, etc. Also familiar with day work and piece work methods. Now in charge of department, but desires a change. Address Box 16, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Nickel-plating, polishing and buffing departments. At present in charge of these departments, but wish to make change. Twenty-five years' experience. Can furnish best references; sober and reliable. Address Box 6, care Brass World, Edison Bldg., New York.

BRASS FOUNDRY FOREMAN—Wanted position as foreman or assistant in brass or aluminum foundry. Familiar with metal mixing machines and all up-to-date methods of molding. Wide experience; good references. Address Box 15, Brass World, Edison Bldg., New York.

For Sale

FOR SALE.—Plating dynamo, Form N, No. 3, Hanson & Van Winkle, complete with rheostat. In first-class condition. Used but a short time. Write Buffalo Scale Co., Inc., Niagara and Ferry Streets, Buffalo, N. Y.

SMALL electroplating outfit used two months. Address Box 9, care of BRASS WORLD, Edison Bldg., New York.

Bone and Ivory Chips Wanted

WANTED—Bone and ivory chips or dust, waste of manufactured articles of bone and ivory. Send prices and samples, also quantities produced. Will pay cash for the right materials. Address Box 14, BRASS WORLD, Edison Bldg., New York.

"I receive your journal regularly and am pleased to say that I find it good and instructive."—W. Mackey, Middleburg, South Africa.

J. H. Zimmerman writes from St. Louis: "I received your July issue and am well pleased with it. Had heard about BRASS WORLD, but hadn't a chance to see it. I inclose dollar for subscription."

Current Metal and Supply Prices

It is impossible in giving a list of current prices of metals and chemicals to do more than to furnish quotations which are approximately correct at the time of going to press. The prices of many of the items included below are influenced by war and other conditions which make them unstable at the present time.

CHEMICALS

Acetone, pure 98-99 per cent.....	\$0.30 lb.	Lead, red (pure).....	.15 lb.
Acid, acetic, pure 30 per cent.....	.10 lb.	Lead, yellow oxide (litharge)	.15 lb.
Acid, arsenious (white arsenic).....	.10 lb.	Liver of sulphur, see Potassium sulphide.	
Acid, boracic (boric), pure.....	.15 lb.	Manganese, metallic, pure and carbon free,	
Acid, hydrochloric, see Acid, muriatic.			1.00 lb.
Acid, hydrofluoric, 30 per cent....	.03 @ .03 1/2 lb.	Magnesium, metallic	3.00 lb.
Acid, hydrofluoric, 48 per cent....	.06 @ .06 1/2 lb.	Mercury bichloride (corrosive sublimate),	
Acid, muriatic, 20 deg.....	.05 lb.	crystals	1.27 lb.
Acid, muriatic, c. p., 20 deg.....	.12 lb.	Nickel and ammonium sulphate (double	
Acid, nitric, 38 deg.....	.05 1/2 lb.	salts)	.08 lb.
Acid, nitric, 40 deg.....	.06 @ .05 3/4 lb.	Nickel carbonate, dry.....	.60 lb.
Acid, nitric, 42 deg.....	.06 1/4 lb.	Nickel, metallic	.60 lb.
Acid, nitric, c. p.....	.14 lb.	Nickel sulphate (single salts).....	.20 lb.
Acid, sulphuric, 66 deg.....	.05 lb.	Nitre (saltpetre), see Potassium nitrate.	
Acid, sulphuric, c. p.....	.12 lb.	Oil of vitriol, see Acid, sulphuric.	
Alcohol, wood	.55 gal.	Paraffin, high viscosity.....	.19 @ .26 lb.
Alcohol, denatured	.55 gal.	Phosphorus	.35 @ 1.00 lb.
Alum, burnt and powdered technical....	.15 lb.	Pitch	.05 lb.
Alum, commercial	.07 lb.	Plaster of Paris, dental	.05 lb.
Ammonium sulphate	3.37 1/2 @ 3.40 lb.	Potassium bichromate, c. p.....	.50 lb.
Aqua-Fortis, see Acid, nitric.		Potassium carbonate	.40 lb.
Ammonia water (aqua-ammonia), 20 deg.,		Potassium cyanide chloride mixture..	.25 @ 29 lb.
	4 1/4 lb.	Potassium iodide	3.15 @ 3.20 lb.
Ammonia water (aqua-ammonia), 26 deg.,		Potassium nitrate (nitre or saltpetre),	
	.06 1/4 lb.		.17 @ — lb.
Ammonia water, c. p.....	.10 lb.	Potassium permanganate	.90 @ .95 lb.
Ammonium carbonate, lump.....	.15 lb.	Potassium, red prussiate	1.30 lb.
Ammonium chloride (sal-ammoniac)...	.09 1/2 lb.	Potassium sulphide (liver of sulphur)....	.20 lb.
Ammonium hydrosulphuret	.25 lb.	Potassium sulphuret, see Potassium sulphide.	
Ammonium sulphate	.07 lb.	Potassium sulphocyanide	.40 lb.
Amyl acetate	3.25 gal.	Pumice, ground	.05 lb.
Antimony (fine powder).....	.25 @ .26 lb.	Rosin, yellow	.08 lb.
Arsenic, metallic	.10 lb.	Sal-ammoniac, see Ammonium chloride.	
Arsenic, white (acid arsenious)	.10 lb.	Sal-soda, see Sodium carbonate.	
Benzol, pure	.90 @ 1.00 gal.	Silver chloride, dry.....	.65 oz.
Bismuth, metallic	2.50 @ 2.55 lb.	Silver cyanide	1.00 oz.
Blue-vitriol	.12 lb.	Silver nitrate, crystals	.45 oz.
Borax, crystals or powdered	.12 lb.	Silver trisalyt	.24 oz.
Borax glass	.30 lb.	Soda-ash	.05 lb.
Carbon bisulphide	.20 lb.	Sodium baborate, see Borax.	
Calcium carbonate (precipitated chalk)..	.10 lb.	Sodium bisulphite	.06 lb.
Chrome-green, c. p.....	.26 @ .30 lb.	Sodium carbonate (sal-soda), crystals...	.02 lb.
Cobalt, metallic, pure and carbon free..	2.50 lb.	Sodium hyposulphite ("hypo").....	.03 lb.
Copper acetate (verdigris).....	.35 @ .40 lb.	Sodium, metallic	1.00 lb.
Copper carbonate, dry.....	.23 lb.	Sodium nitrate	.05 lb.
Copper, sulphate (blue-stone).....	.12 lb.	Sodium phosphate (crystal)	.06 lb.
Copper trisalyt	.30 lb.	Sodium silicate (water-glass)	.05 lb.
Copper cyanide	.45 lb.	Spelter, see Zinc.	
Corrosive sublimate, see Mercury bichloride.		Sugar of lead, see Lead acetate.	
Cyanide, see Potassium cyanide.....	.30 lb.	Sulphur (brimstone), in lump.....	.06 lb.
Dextrin	.15 lb.	Tin chloride	.43 lb.
Emery flour	.05 lb.	Turpentine, spirits of	.55 gal.
Emery, F F & F F F.....	.03 lb.	Verdigris, see Copper acetate.	
Flint, powdered	25.00 ton	Water-glass, see Sodium silicate.	
Fluorspar	30.00 ton	Wax, beeswax, yellow	.30 @ .33 lb.
Fusel-oil	3.35 gal.	Wax, carnauba	.45 @ .47 lb.
Gold chloride	11.75 oz.	Whiting (ground chalk)	.05 lb.
Gold trisalyt	10.00 oz.	Zinc, carbonate, dry	.25 lb.
Iron perchloride (110 lb.).....	.20 lb.	Zinc, chloride	.15 lb.
Iron sulphate (copperas)	.05 lb.	Zinc cyanide	.70 lb.
Lead acetate (sugar of lead).....	.17 lb.	Zinc, sulphate	.05 lb.
Lead, pig, trust price.....	.05 3/4 lb.	Zinc (spelter)	.22 lb.
		Zinc, trisalyt	.28 lb.

METALS

Aluminum, 99 per cent.....	32.00 to 34.00	Lead, outside	4.45 to 4.50
Antimony, Chinese and Japanese..	33.50 to 34.00	Nickel, nominal	.50.00
Cadmium, nominal	1.25 to 1.70	Platinum, soft, nominal	40.00
Copper, electrolytic	17.00 to 17.25	Silver (official)	.48 1/4
Copper, casting	16.37 to 16.63	Spelter, prompt western	13.45 to 13.70
Lead, trust	4.50	Spelter, spot, nominal.....	13.50 to 13.75

All price lists on brass and copper products have been withdrawn and quotations are based on the outside market.

The Brass World & Platers' Guide

Volume XI
Number 9



New York
September, 1915

A Monthly Journal Devoted to the Art of Refining, Alloying, Casting, Rolling
Founding and Electroplating of All the Non-Ferrous Metals and their Alloys

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A Notable Event in Foundrydom

What might be termed the "modernization of the foundry" has been effected almost entirely within the past twenty years, as it is during this period that the greatest advances have been made, not only in the purely mechanical end of the business, the production of castings and methods of melting and mixing of the metals, but in easing the lot of the worker and making the foundry a more desirable place in which human beings shall live their working hours. In place of the dark, damp, unventilated and unheated frame buildings of the past, we now have fine structures of steel, brick and concrete, lighted by large areas of glass by day, and by numerous arc and incandescent lamps at night. The various improvements that have been made are too extensive to be enumerated, even were it necessary; they have extended to all branches of the foundry industry, as every foundryman is well aware whose active career has covered the period in question.

These changed conditions are primarily due to the great educational movement that had its inception in the formation of the American Foundrymen's Association twenty years ago; the most notable event in the history of founding, an event that could hardly fail to result in good to the entire trade, for had little else been accomplished other than to bring foundrymen together to become acquainted with each other and with the men who furnish the supplies and build the machines, the formation of such an organization would have been well worth while, for once foundrymen got to know each other, distrust vanished, and it did not take long to discover that none had a monopoly of foundry knowledge, and that mutual advantage resulted from discussing with each other the various problems and difficulties encountered and the manner in which they were solved or surmounted.

The exhibition of foundry machines and supplies became a regular feature of the Conventions some ten years after the formation of the Foundrymen's Association, although they had been held in a small and informal way for several years previously. The American Brass Founders' Association, now the American Institute of Metals, was formed in 1907, at the twelfth meeting of the American Foundrymen's Association again held in Philadelphia. These three Associations find it to their mutual inter-

est to always meet together, and thereby form a combination that ought to powerfully appeal to all who are in any way interested in foundry work, making it a duty they owe themselves to attend the Conventions as they are certain to acquire knowledge that will repay with interest the expenses of the trip to the convention city.

Substitute for Copper-Zinc

One of the vice-presidents of the British Institute of Metals, Prof. H. C. H. Carpenter, M.A., Ph.D., has recently been appointed a member of the War Inventions Committee by the British Government. Professor Carpenter is well known on this side of the Atlantic because of the excellent work he has done in connection with the metallurgy of the non-ferrous alloys, and notably on the alloys of copper and aluminum. The results of these latter investigations undertaken in conjunction with Professor Edwards are embodied with painstaking attention to detail in the Eighth Report to the Alloys Research Committee of the Institution of Mechanical Engineers, London. Professor Carpenter, because of the amount of work he has done in connection with them, is greatly interested in the alloys of aluminum and copper, and has been credited with having recently called attention to the suitability of the copper-aluminum alloys as substitutes for brass in the making of munitions of war; probably in the shape of cartridge shells.

While there is little doubt that the 5 and 7 per cent aluminum alloys possess sufficient ductility to enable them to be used in place of brass for making such things as cartridge shells, we fear that many more difficulties will be encountered than in the case of brass before they reach the shape of the finished article.

In the first place the aluminum alloys are more troublesome to cast than the zinc alloys on account of the dross which forms with such facility. This difficulty of course can be overcome, and has been in this country, and also probably in England, but it is a secret known to few; and there are some metallurgical secrets even yet, probably more than the ordinary man would believe. This particular secret consists in making a "flux" that will dissolve Al_2O_3 permitting clean castings to be made which at the same time are free from porosity. This is not very easy, for aluminum bronze is a

ticklish proposition, and while there are a number of combinations of salts that will dissolve alumina, unfortunately most of them render the alloy so porous that it resembles a sponge cake.

This difficulty can be overcome and has been, for we are creditably informed that at least one concern is making its aluminum bronze ingots for rolling by pouring them from the top and is getting clean castings, but as before remarked, few can do this.

Another, and probably greater difficulty, is caused by the scale that forms on the surface of aluminum bronze during rolling or drawing operations. This scale possesses such abrasive qualities that it cuts and scores the dies making the operation of drawing considerably more expensive than in the case of brass.

Those who are familiar with the peculiarities of aluminum bronze are not sanguine about its future in rolled or drawn work. It is an excellent alloy, or rather they are excellent alloys; as the content of aluminum may vary producing a plurality of alloys, but their field appears to be quite narrow compared to brass, and while they may be used as substitutes for the latter alloy in a pinch it is not at all likely they will supersede brass no matter how scarce spelter may temporarily become.

Retrospect of the Old Metal Market for the Month of August

In reviewing the Scrap Metal Market of the past month, we find pervading the entire month, a great deal of irregularity and a confusion of sentiment regarding the course or turn of events as applying to the metal trade. Speculation was rampant in old as well as in new metals. Stability was therefore lacking in nearly all old metals.

The month opened with a state akin to demoralization. War orders did not seem to help any, except for such specialties as were needed for them. This included new brass sheet clippings and new tubing scrap and brass rod turnings. These were more or less in demand throughout the entire month with variations in prices as affected by the fluctuations in spelter. The domestic consuming trade, that of the brass foundries, did not show any improvement. The second week of August showed no betterment. Here and there an order was put out, and in the filling of same, some show

of activity in the grade of metal called for developed, but eventually subsided. A good call for old brass cartridge shells developed for war order purposes, but they were found to be very scarce. A sluggish movement in copper scraps continued. Zinc scrap took a great tumble and lead scraps, following the course of the new metal, also sank in value. This caused a great depression in sentiment. By the way, sentiment is a factor which must be reckoned with in the old metal business, and it becomes almost as imperative to study the sentiment as the prices and the conditions.

Throughout the past month the aluminum scraps were the one bright star in the firmament and continue so up to present writing. While everything else had risen in the line of metals after the war started, lead and aluminum remained dormant. Eventually lead started on its sudden upward turn and advanced rapidly to the utter demoralization of the trade, and speculation in it became intense. But this meteoric flight was just long enough to inveigle the speculators, and most of the paper profits were lost in the sudden halt and decline. Since then lead has behaved remarkably well and became most conservative. Not so aluminum. That is experiencing the biggest boom in its history, after being dormant until long after the war commenced, and everything else had been stirred. In the third week in August occurred the continued persistent decline of copper, manifest manipulations by London brokers and the consequent decline here, not only of the new copper metal, but also the scraps. The entire market was upset. Zinc scraps suffered most and reached lowest levels in their recent career.

Such an unusually staple article as composition scrap was absolutely neglected the entire month. Heavy scrap brass fared some better, owing to export orders. In this connection, we remark that the scrap metal export business, which had been of very large volume, has largely disappeared, shrinking to a minimum.

About the third week in August, the stir in the iron trade and the publication by the papers and agencies of favorable things about this trade, also about the crops, seemed to indicate better things to come for the metal dealers. But such have not yet come, and the market continues about in the same sluggish condition as heretofore.

CONVENTION OF AMERICAN FOUNDRYMEN'S ASSOCIATION

MEETING OF THE AMERICAN INSTITUTE OF METALS

Atlantic City, Sept. 28th to Oct. 1st.

Headquarters, Hotel Traymore.

The twentieth annual meeting is now in organized condition. The Hotel Traymore has been the final choice for headquarters, but the registration headquarters will be on the Young's Million Dollar Pier, where the exhibits are installed.

There will be an informal dance on the evening of Sept. 27 on Young's Pier. This will start the ladies' entertainment. The next evening, Tuesday, there will be a theater party. Thursday, the ladies will be guests at the annual banquet of the Association at the Traymore. This will be entertaining from the intellectual point of view, as John Kendrick Bangs will speak to the subject "Celebrities I Have Met."

As for free chair rides on the boardwalk, and admissions to the chief entertainments bordering thereon, the ladies who have registered at headquarters will be amply provided with free tickets.

The following committee of ladies has been organized to assist in the entertainment of the visitors: Mrs. R. A. Bull, Granite City, Ill.; Mrs. G. H. Clamer, Philadelphia; Mrs. A. O. Backert, Cleveland; Mrs. W. M. Corse, Buffalo; Mrs. W. H. Bassett, Waterbury, Conn.; Mrs. Carrie Begley, South Langhorne P. O., Pa.; Mrs. Howard M. Bougher, Philadelphia; Mrs. H. A. Carpenter, Providence, R. I.; Mrs. A. F. Corbin, New Britain, Conn.; Mrs. Alex T. Drysdale, Burlington, N. J.; Mrs. P. J. Flaherty, New Castle, Pa.; Mrs. C. E. Hoyt, Chicago, Ill.; Mrs. Alfred E. Howell, Nashville, Tenn.; Mrs. Walter T. MacDonald, Philadelphia; Mrs. Richard Moldenke, Watchung, N. J.; Mrs. L. W. Olsen, Mansfield, Ohio; Mrs. F. N. Perkins, Freeport, Ill.; Mrs. J. H. Sheeler, Germantown, Philadelphia; Mrs. E. M. Taggart, Philadelphia; Mrs. M. R. Taggart, Philadelphia; Mrs. Arthur W. Walker, Watertown, Mass.

The mere male members who have been stung with the golf microbes are to have the course of the Atlantic City Country Club, at Northfield, placed at their disposal. There will be a small fee charged. The com-

mittee who will hold the golf enthusiasts to form is as follows: H. M. Bougher, chairman, and Howard Evans, J. W. Paxson Co.; W. J. Coane, Ajax Metal Co.; Wm. J. Devlin, Thomas Devlin Mfg. Co.; Howard C. Matlack, Marshall, Matlack Co.; H. P. Rebman, American Engineering Co.; Otto Schaum, Schaum & Uhlinger Co.; J. H. Sheeler, Sheeler-Hemsher Co.; W. P. Smith, Wm. Cramp Ship & Engine Building Co.; E. P. Williams, Baldwin Locomotive Works.

The manufacturing plants within a radius of 100 miles or so that may be reached with utmost convenience, due to ample transit service, have extended hearty invitations to all who are curiously inclined, and to help in the work of inspection, the following committee will be on the job: Harold W. Brown, chairman, Tabor Mfg. Co.; Harry E. Asbury, Enterprise Mfg. Co.; W. J. Coane, Ajax Metal Co.; Geo. C. Davies, Pilling & Crane; Harry Drinkhouse, Thomas Devlin Mfg. Co.; Thomas Evans, Eynon-Evans Mfg. Co.; Chas. H. Harrar, Midvale Steel Co.; J. S. Hibbs, J. W. Paxson Co.; Wilfred Lewis, Tabor Mfg. Co.; Geo. F. Pettinos, Pettinos Bros.; Wm. H. Ridgway, Craig Ridgway & Son Co.; F. L. Shepherd, I. A. Shepherd Co.; A. G. Warren, J. W. Paxson Co.; Robert Wetherill, Jr., Robert Wetherill & Co.

In previous issues we have given the list of speakers at the convention and the titles of papers to be read and discussed. The final and probably complete condensed program is appended.

Monday, Sept. 27

Registration, Young's Million Dollar Pier.

8.00 p. m.—Informal dance, Young's Million Dollar Pier.

Tuesday, Sept. 28

10.00 a. m.—Joint session, Convention hall, Young's Million Dollar Pier.

2.30 p. m.—Professional session, Convention hall, Young's Million Dollar Pier.

8.00 p. m.—Theater party for members and ladies of the American Foundrymen's Association and the American Institute of Metals.

Wednesday, Sept. 29

10.00 a. m.—Professional session, Convention hall, Young's Million Dollar Pier.

2.30 p. m.—Gray Iron session, Convention hall, Young's Million Dollar Pier.

8.00 p. m.—Annual business session, Banquet room, Hotel Traymore.

Thursday, Sept. 30

10.00 a. m.—Steel session, Convention hall, Young's Million Dollar Pier.

10.00 a. m.—Malleable session, Annex to Convention Hall, Young's Million Dollar Pier.

2.30 p. m.—Steel session, Convention hall, Young's Million Dollar Pier.

2.30 p. m.—Malleable session, Annex to Convention hall, Young's Million Dollar Pier.

7.00 p. m.—Annual banquet, Hotel Traymore.

Friday, Oct. 1

10.00 a. m.—Final business session, Convention hall, Young's Million Dollar Pier.

The Exhibition

The foundry exhibit will be the best in the history of the organization.

This show is scheduled for the psychological time when foundrymen and manufacturers are going to have uppermost in their minds the making of purchases to meet their increased needs.

Thursday, Sept. 30, will be Philadelphia Day at the Convention. All the foundries in Philadelphia and vicinity will be asked to close their shops on that day. Special excursion trains will take them to Atlantic City. There have been some lean years in the foundry business, but remember that "the future always pays the debts of the past," and payment is about due.

List of Exhibitors

Ajax Metal Co., Philadelphia. Ingot metals and castings.

Arcade Mfg. Co., Freeport, Ill. Molding machines in operation.

Atkins, E. C., & Co., Indianapolis. Saws.

Ayer & Lord Tie Co., Chicago. Creosoted wood blocks.

Berkshire Mfg. Co., Cleveland. Molding machines.

Besly, C. H., & Co., Chicago. Grinding machinery.

Birkenstein, S., & Sons, Chicago. Castings, brass, etc.

Blystone Mfg. Co., Cambridge Springs, Pa. Facing mixer.

Brown Specialty Machinery Co., Chicago. Cone machine in operation, electric shaker and sand blast machine.

Buckeye Products Co., Cincinnati. Foundry specialties.

Buch Foundry Equipment Co., Bridgeport, Pa. Operating exhibit of molding equipment, also roll over and pattern drawing machine.

Carborundum Co., Niagara Falls. Carborundum products.

Drop in on Us at the Convention

The BRASS WORLD will be represented at the Foundrymen's Convention at Atlantic City by several members of the staff. Charles Vickers, editor; C. N. Manfred, business manager, and George K. Myers, advertising representative and possibly one or two other representatives will be in attendance.

We extend a special and personal invitation to every delegate and visitor to call at our booth and get acquainted. Our "Glad-hand" committee will be there to welcome you.

Cataract Refining & Mfg. Co., Buffalo. Core oils.

Clark, Chas. J., Chicago. Blast meters.

Clark Foundry Co., Rumford, Me. Combined punch and shear.

Clearfield Machine Shops, Clearfield, Pa. Model of 50,000 lb. wet pan in operation.

Cleveland Automatic Machine Co., Cleveland. Automatic machine, motor driven.

Cleveland Pneumatic Tool Co., Cleveland. Air tools of all kinds.

Clipper Belt Lacer Co., Grand Rapids. Belt lacers and hooks.

Dixon, J., Crucible Co., Jersey City. Graphite products.

(Continued on Page 362)

Where the Convention and



A Scene on the Beach



Exhibition Will Be Held



Hotels from the Ocean



- Gardner Mch. Co., Beloit, Wis. Grinding machines.
- General Electric Co., Schenectady. Arc welding equipment, also centrifugal compressor for cupola operations.
- Goldschmidt Thermit Co., New York. Alloys for foundry use, heating thermit cans, also titanium thermit cans.
- Graceton Coke Co., Graceton, Ind. Foundry coke.
- Gt. Western Mfg. Co., Leavenworth, Kan. Gyratory foundry riddles.
- Hardy, F. A., & Co., New York. Safety glasses and eye protectors.
- Hayward Co., New York. Electric motor clam shell bucket, also midget derrick outfit.
- Herman Pneumatic Mch. Co., Zelienople, Pa. Molding machines in operation.
- Herold, Bros. Co., Cleveland. Foundry brushes.
- Hill & Griffith Co., Cincinnati. Foundry supplies, but not on display.
- Ingersoll-Rand Co., New York. Pneumatic tools.
- International Molding Mch. Co., Chicago. Molding equipment.
- International Steam Pump Co., New York. Air compressor, sand riddles, etc., shown in operation.
- Jennison Wright Co., Toledo. Creosoted wood block flooring.
- King, J., Optical Co., New York. Foundry goggles.
- Landis Tool Co., Waynesboro, Pa. Grinding machine in operation.
- Lehigh Coke Co., So. Bethlehem, Pa. Products shown by pictures.
- Lincoln Electric Co., Cleveland. Arc welding outfits.
- Lupton's, D., Sons Co., Philadelphia. Lighting and ventilating products.
- Macleod Co., Cincinnati. Sand blast machine, oxy-acetylene welding torch, etc.
- Malleable Iron Fittings Co., Branford, Conn. Steel vibrators.
- McCormack, J. S., Co., Pittsburgh. Foundry supplies.
- Midland Mch. Co., Detroit. Molding machine in operation, core-making machine, etc.
- Monarch Engineering & Mfg. Co., Baltimore. Furnaces.
- Mott Sand Blast Mfg. Co., New York. General line sand blast apparatus, new type barrel in operation, also bore type machine, etc.
- Mumford, E. H., Co., Elizabeth, N. J. Molding machines.
- Mumford Molding Mch. Co., Chicago. Molding machine in operation.
- National Engineering Co., Chicago. Core sand and facing mixer in operation.
- New Haven Sand Blast Co., New Haven, Conn. Sand blast rolling barrel, also automatic hose-type machine.
- Norma Co. of America, New York. Ball and other bearings.
- Norton Co., Worcester, Mass. Grinding machines.
- Obermayer, S., Co., Chicago. Reception booth only.
- Osborn Mfg. Co., Cleveland. Molding machines.
- Oxweld Acetylene Co., Chicago. Cutting and welding equipment.
- Pangborn Corp., Hagerstown, Md. Sand blast machines, etc.
- Paxson, J. W., Co., Philadelphia. Sand blast cleaning equipment.
- Pickands, Brown & Co., Chicago. Solvay coke.
- Pridmore, H. E., Chicago. Molding machines.
- Ready Tool Co., Bridgeport, Conn. Various tools for several purposes.
- Rickey, Browne & Donald, Maspeth, N. Y. Molding machine in operation.
- Robeson Process Co., New York. Showing samples of glutrin.
- Rogers, Brown & Co., Cincinnati. Processes of iron making from mine to foundry by moving picture demonstration.
- Sand Mixing Machine Co., New York. Machine for preparing molding sand.
- Sly, W. W., Mfg. Co., Cleveland. Sand blast barrel in operation.
- Smith, R. P., & Sons Co., Chicago. Shoes for molders.
- Snyder Electric Furnace Co., Chicago. Electric furnace.
- Standard Sand & Mch. Co., Cleveland. Batch mixer and core pulverizing machines.
- Sterling Wheelbarrow Co., West Allis, Wis. Foundry flasks.
- Stodder, W. F., Syracuse, N. Y. Broughton core sand mixer, suction sand blast nozzle.
- Strong-Kennard & Nutt Co., Cleveland. Protection glasses and goggles.
- Stuart American Products Co., Memphis, Tenn. Burner for fuel oil.

(List of Exhibitors Continued on Page 389)

Systematic Recording of Patterns

By "MOSS ISAACS"

In the writer's wanderings around different foundries, he has often been struck, metaphorically, of course, with the many different and often haphazard ways of keeping a record of patterns and core boxes that have been received from customers.

It has been with a feeling almost akin to sorrow that I have seen the office help wade through a drawer full of delivery slips to see whether a certain pattern had been returned or not, while the customer was awaiting a reply by telephone. And invariably somebody in the foundry had to be

card system. The ledger method of book-keeping is now practically obsolete and, personally, I have always found that the index cards were preferable.

It is possible, however, for a man to have a predilection for ledgers, and with this thought in view, advice upon how to record the entries therein may be tendered.

Fig. 1 shows how a page of the day book can be ruled to meet requirements, and should it be so desired, an extra column can be given to enter the name of the article as finally made, such as bushing, piston, hub, cap, etc.

All patterns and core boxes received

			THEIR NO.
			43-2
CUSTOMER:	Smith, Jones and Co.		OUR NO.
ADDRESS:	New York City.		99
PATTERN:	1 Wood (Split)	L.P. None.	LOCATION:
CORE-BOXES:	1 Wood (2 Sections)	L.P. None.	SECTION: 4.
DESCRIPTION:	Bushing.		SHELF: 6
REMARKS:			
DATE RECEIVED:	SENT TO:	DATE:	REMARKS:
Jan. 9. 1912.	Smith, Jones & Co.	Feb. 4. 1912.	
Aug. 1. 1912	X.Y.Z. Pattern Co.	Aug. 7. 1912.	Repairs to C/B.
Aug. 12. 1912.	Brown Brass Co.	Sept. 3. 1912.	Request of Smith, Jones & Co.

Fig. 1

resorted to, thus making it purely a case of remember!

In a foundry of any size a system for the recording of the coming and going of patterns is most always in vogue; some are good, some otherwise, and to this effect my remarks are directed mainly at the "little man," or the so-called "one-horse" shop.

The office help, generally one girl in the small shop is not, as a rule, so overburdened with work, but a few moments could be spared to record a pattern entry correctly, and when the habit is formed, it is, like all good practices, hard to depart from.

Assuming, then, that it has been decided to index patterns, how shall the man in a small business record them? There are two courses open, viz.: the ledger and the index

should be given a foundry serial number and entered in the day book as received, and then entered in the ledger.

Numbering Serially

Numbering serially is a controversial subject. Some prefer a letter and number combination such as A1 to A1000, then B1 to B1000, until the entire alphabet has been gone through, thus giving a record of handling 26,000 patterns, when a double letter would be resorted to such as AA1 to AA1000 until ZZ1000 had been reached, giving another 26,000 patterns, or a total of 52,000, which in the ordinary course of business, will take quite a few years to accomplish. Personally, I prefer serial numbers to be just merely figures, as by this method there

is no finality. It will be seen that the sample day book page has been thus started (Fig. 1).

Numbers, not combined with letters, can also be used when arranging racks in the storage room.

The disadvantage of the ledger system is that the customers' names are not recorded in strict alphabetical order, neither can the patterns be expected to be recorded numerically, so for a system that for all purposes is simply perfect and perfectly simple, allow me to express my liking for index cards. Of course a loose-leaf ledger would give an alphabetical list of customers, but the pattern numbers would not be in strict numerical order, which is greatly to be desired.

In recording receipt of patterns upon individual cards the same procedure as re-

that the pattern was originally received upon Jan. 9, 1912, and returned to the customer again upon Feb. 4, 1912. It was away from the foundry for over a year and was received again upon Aug. 1, 1913, when the core box was found to have been damaged in transit. The broken core box was dispatched to the local pattern maker the next day and was received back at the foundry two days later. Upon Sept. 3, 1913, at the request of the customer, the pattern was shipped to a competitor!

The reverse of the card, as shown in Fig. 3, can be a record of the coming and going of the pattern.

Needless to remark, all core boxes and loose pieces should be of the same serial number as the pattern, although the writer has seen different methods.

CUSTOMER:	Smith, Jones and Co.	OUR N°:	
ADDRESS:	New York City.		99
PATTERN:	1 Word (split)	THEIR N°:	
CORE-BOXES:	1 Word (2 Sections)		43-2.
DESCRIPTION:	Bushing.	DATE:	
REMARKS:			Jan. 9, 1912.

Fig. 2

gards numbering serially can be indulged in, and about a 4-in. x 2-in. card could be used handily, and these could be filed away with the serial numbers as the guide. Fig. 2 will show what is meant. This series of cards would take the place of the day book in the ledger method.

A card larger than 4-in. x 2-in. would be necessary for recording alphabetically the different customers, thus a 5-in. x 3-in. may be used advantageously.

From a perusal of Fig. 3 it will be seen that all particulars can be recorded, and that all cards can be filed strictly alphabetically and numerically (how different from the ledger!) with the customer's pattern number uppermost, which is a reversal from the card shown in Fig. 2, where the serial number is given the place of prominence.

Referring to Fig. 3 again, it will be noted

Now that we have a system whereby we can record the patterns entering or leaving the foundry, we must identify the patterns after being stored, and also when in the foundry. For this purpose a small label affixed to the patterns and core box will render recognition

and storage easy. Such labels need not be printed especially for the occasion. Shellac is the best for affixing, and a coat over the label will preserve the figures from finger marks and wet sand. The figures on the label are arranged in rows separated by dashes. The upper row gives the customer's number; the second row the foundry number, and the third row indicates where the pattern is stored, as for instance, 4-6, meaning section 4, shelf 6.

The Patterns Should Not Be Marked

It is not always advisable to give location upon patterns because many have to be returned along with the castings and furthermore, the writing of the pattern's location upon the index card should be done with pencil, because if a pattern be away from a foundry for any considerable time, it is quite possible that the space it occupied

upon the shelf has been filled with a newly acquired pattern.

The advantage of having a location mark upon the pattern is that it can be taken directly from the foundry to the storage room without referring to the cards each and every time, but such marking is only advisable when it is known that the pattern will not have to be returned to the customer at once.

One disadvantage of the ledger system not before mentioned, is that it is hard to keep a proper record when the same pattern is received in the same foundry more than once; and from experience I know that some concerns are cranks about having their patterns returned immediately an order is fin-

Should the storage be maintained in a loft over a room where machinery is running, I strongly advise that all core boxes and loose pieces be tied to the patterns, thus preventing the vibration of the machinery scattering the pieces about.

The initial cost of installing cards and cabinets compares very favorably with the purchase of ledgers, and the knowledge that the patterns can be located immediately will more than compensate for a possible little extra time expended in the making of the records.

On Zinc Poisoning

In a discussion of occupational diseases in the *Journal of Industrial and Chemical*

OUR NO.	CUSTOMER'S NO.	CUSTOMER.	ADDRESS.	PATTERN	CORE-BOXES.	DATE RECEIVED	DATE RETURNED.
1	84-2	National Ry. Co	Pasadena, Cal.	1 Split Wood	Use Stock Box	10-4-11.	9-2-12.
2	994-B	International Ry. Co	Chicago, Ill.	1 Wood.	{ 1 Metal 2 Sections }	10-9-11.	
3	892-1.	Ward Motor Co	Portland, Me.	8 Metal - Gated	None.	10-10-11.	
4	12345.	Golden Watch Co	Holyoke, Mass.	{ 1 Wood - 2 Metal Loose Pieces }	1 Wood	10-12-11.	
5	654	Mutual Mirror Co	Lima, Ohio.	{ 4 Wood on 1 Sack }	Use Stock Box	10-15-11.	2-4-13.
6	0-5-1.	Universal Knitting Co	Providence, R. I.	{ 1 Split Wood 4 Wood Loose Pieces }	{ 1 Wood - 2 sections 1 Wood - 1 Wood L F }	11-2-11.	
7	C184.	Premier Mfg. Co	Buffalo, N. Y.	2 Metal } One	None.	12-4-11.	
8	C185.	do.	do.	2 Metal } Gate	None.	12-4-11	
9							
10							

Fig. 3

ished, even if they issue a repeat order the following week! By using cards all difficulty is avoided.

Some foundries prefer the system of giving a new serial number to the same pattern every time it is received, which appears absurd when the pattern is away only a short time.

If necessary, the card to be used, as shown in Fig. 3, may be larger than 5 in. x 3 in., thus giving more room for the description of core boxes should there be more than one, and under the item of remarks, information could be written as to whether or not the same core box is used for another pattern, or if chills are used, etc.

Foundries operating their business in a two-story building oftentimes have the core making department upon the second floor with the core box storage separate from that of the patterns, but for the foundry which comes within the scope of this article it is better to store both patterns and core boxes together.

Engineering reference has been made to the form of zinc poisoning known as "spelter chills." Zinc smelters are less subject to metal poisoning than are lead smelters; so much less indeed that some persons are disposed to deny that zinc vapor is poisonous, attributing the trouble experienced by brass-makers to copper vapor alone.

H. W. Gillett appears to have brushed aside that hypothesis. He cites the evidence of Lehman, who produced "spelter chills" in several persons, including himself, by the inhalation of fumes arising from c.p. zinc and found the symptoms to be identical with those of "brass shakes."

How to Preserve Reference Tables

Reference tables are very convenient to use, but they soon become dirty and torn in constant use. This may be prevented by dipping them in lacquer. Use a shallow tray, place the lacquer in it and lay in the prints, then remove and hang them up to dry. This makes the paper dirt-proof and also toughens it.

FROM AMBER TO DYNAMO

Part X—Magnetism and Electromagnetism

By H. E. Willmore, Jr., B.S.

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Magnetism is an element even more occult and uncanny in nature than electricity. When electricity passes through space we see a spark or sometimes a flash of lightning, when we get too close to it we get a jolt, and near large generators the nose detects the characteristic odor of ozone. Magnetism, on the other hand, has no direct effect on any of the senses; we cannot hear, see, feel, or smell it. The fact that a mere piece of metal can stretch out invisible tentacles and with a live force pull other pieces of metal to itself, is something indeed that smacks of the Black Art, and for anyone who likes to dabble in the mysterious and unknown, magnetism presents an interesting field for study.

The ability of iron and steel to become magnetic and to thus attract other pieces of iron and steel is a phenomenon so well known to everyone that the more elementary aspects of the subject of Ferromagnetism should be passed over rather briefly. At the same time, we shall endeavor to avoid complicated mathematics, as in handling a subject of this kind it is quite easy to run into expressions that are so painfully mathematical that not everyone has the patience to try to understand them. A few other substances, such as nickel and cobalt, also possess magnetic properties; but excepting with iron and steel, the magnetic effects are so slight as to be of no practical value. A magnet is able to "induce" magnetism in another magnetic substance near it so that this second substance is capable of attracting other magnetic substances. In the case of soft iron this induced magnetism does not persist very long after the removal of the first magnet. Hard steel is much more difficult to magnetize, but holds its magnetism much longer, and is said to have the property of "retentivity." High retentivity is desired in making permanent magnets for magnetos, etc., and is gained by hardening the steel and further by the addition of a little tungsten.

The exact nature or causes of magnetism are little understood; but its effects have been quite thoroughly studied out. As is well known, the two ends of a bar magnet are not the same; it is said to have a north and a south pole. A south pole on one magnet will attract the north pole of another, but will repel the south pole. Or by the Law of Magnets: like poles repel, unlike poles attract. If a sheet of paper be placed over a bar magnet and iron filings shaken on it, they will arrange themselves in continuous loops extending from one pole to another as in figure 20A, showing that some sort of invisible emanation travels from one pole to another. Or if the magnet be dipped into the filings, they will cling to each end and stick out like so many bristles, as shown in Fig. 20B. Mainly because of the appearance of the filings under these conditions, the magnetic emanations are spoken of as "lines of magnetic force." The unit of magnetic force is based upon the force with which two poles of equal strength, placed a certain distance apart, repel or attract each other. Measured in this way it is found that the two poles of a magnet are equal in strength. The attraction or repulsion between two magnetic poles is directly as the product of their two strengths and inversely as the square of the distance between them, or by Coulomb's

Law:
$$F = \frac{mm'}{r^2}$$
 where m = strength of

one magnet, m' = the strength of the other magnet, and r = the distance between them. The region occupied by lines of magnetic force is called a "magnetic field" and its strength at any point is measured by the force with which it acts upon the pole of a magnet whose strength is known. It is not proposed, however, to go any further into the subject of magnetic measurements, because the plater will never have occasion to use such knowledge in his work.

Molecules Themselves Are Magnets

If a bar magnet be broken in two, the two parts themselves become small magnets, and as far as anyone is able to divide a magnet, the resulting small parts are still magnets, which points to the conclusion that the molecules themselves are magnets having north and south poles. According to this theory, in an unmagnetized piece of iron the molecules are arranged similar to

no matter how great the magnetizing force, which would seem to correspond to a condition in which all the molecules are arranged in the proper order and there are no more left to be brought into play. In magnetizing a piece of steel from a permanent magnet, we usually "stroke" the magnet with the unmagnetized piece. The stroking aids in the magnetization merely because it causes the molecules to be shaken up slightly while under the magnetic influence and thus they are more easily arranged. Holding the piece of steel near the magnet and tapping it with a hammer, or heating it up, which causes the molecules to vibrate, and then suddenly cooling it near the magnet have the same effect of magnetizing the piece.

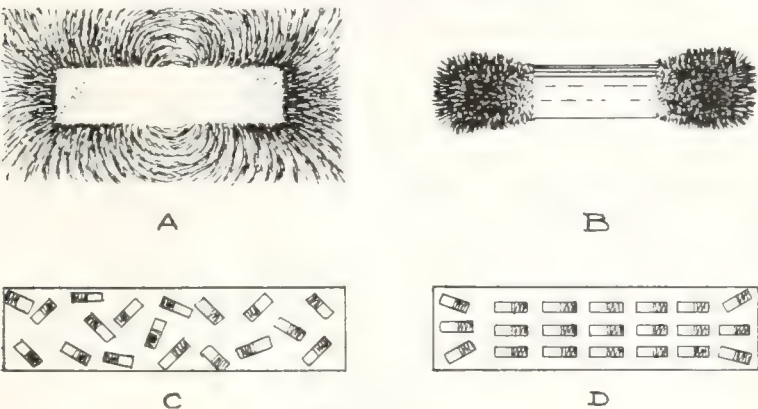


Fig. 20

Fig. 20C, in such disorder that the magnetic effects of the poles oppose and neutralize each other; magnetization simply consists in arranging these small primary magnets in some regular order as in Fig. 20D, so that instead of defeating each other's efforts, they all get together for the common cause and the combined pull is made quite perceptible. To use an analogy, we might liken the first case to a bunch of shiftless beggars fighting over an old coat and all pulling in different directions, with the result that the object of contention itself remains practically stationary. The other case would be paralleled if these same gentlemen were influenced by some outside force, such as the village constable, to the end that they all took hold of a rope attached to a load of boulders and pulled in the same direction toward the stone pile. In soft iron the molecules are held rather loosely and thus are comparatively easily turned about, so that soft iron is easily magnetized and demagnetized. In hard steel, on the other hand, the molecules are not so free and while the steel is hard to magnetize, it is just as hard to demagnetize. The fact that shocks and heating, which of course would derange the molecules, tend to demagnetize a magnet helps to corroborate this theory. Another point in evidence is that a piece cannot be magnetized beyond a certain strength, known as the "saturation point,"

Magnetism follows magnetic substances much the same as electricity follows electrical conductors. This property of conducting magnetism is known as "permeability" and corresponds to the "conductivity" of the electrical conductor. The permeability of air is chosen as unity, and the permeabilities of other substances expressed as a multiple of the permeability of air, which in the case of soft steel and iron

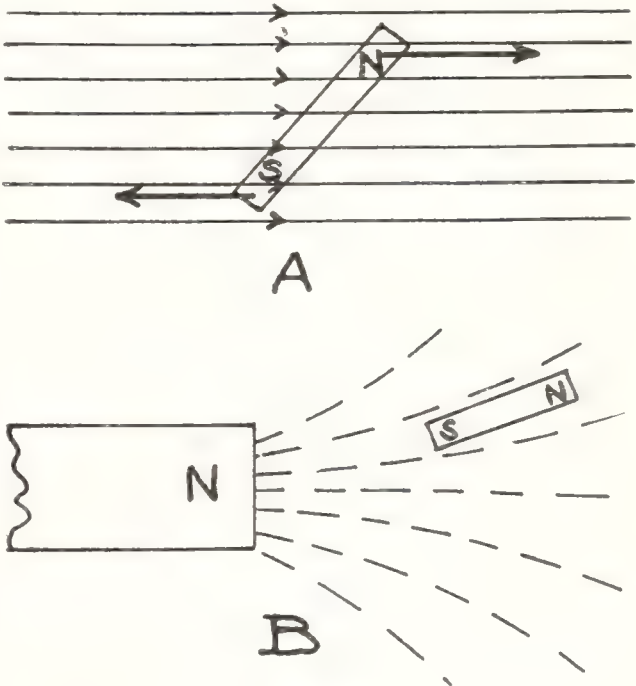


Fig. 21

runs into the tens of thousands. The tendency of a substance to oppose the flow of magnetism is called "reluctance," represented by R , and is analogous to the electrical resistance of conductors. Continuing

this analogy, it is seen that the reluctance of a magnetic circuit varies directly as the length of the path and inversely as the permeability of the substance and the cross-section of the path. If the circuit is composed of several different materials, the total reluctance is obtained by adding the reluctances of each part of the path. Inasmuch as air has such an extremely low permeability, it will be seen that an air path has a very much greater reluctance than the same sized path in iron, for which reason in designing magnetic circuits it is always desirable to make the air gaps as short and of as large cross-section as possible. Magnetism will of course follow any path of low reluctance near it rather than travel through air. For example in the center of a bar magnet or at the curve in a horse-shoe magnet the magnetic lines will not travel outside of the iron and the magnet will not attract anything right at this point. This is the reason also for having "magnetic shields" of soft iron around motors and generators. The magnetic lines of force follow the iron circuit and cannot go outside of the machine where they might cause injury to electrical measuring instruments or watches that might be in the vicinity.

The amount of magnetism flowing through iron is called "magnetic flux," represented by F , and the amount per unit cross-sectional area is called "flux density," which is represented by B in mathematical formulas. The intensity of the field produced by a magnet is represented by H , which means that H units of magnetic force pass through every unit of cross-section; while the total magnetic force of the field is represented by M . Magnetic flux is analogous to current and magnetic force is analogous to electromotive force. Thus we

have the formula, $F = \frac{M}{R}$, which is quite

similar to Ohm's Law, $I = \frac{e}{r}$. For unit

length of path and unit cross-section we have the expression, $B = uH$, where u stands for permeability; so we see that in magnetizing a piece of iron, the flux density produced is proportional to the intensity of the field applied and also to the permeability of the iron being magnetized.

If a bar magnet be placed in a uniform magnetic field, as in Fig. 21A, forces act

upon it as shown and tend to rotate it until it becomes parallel with the direction of the lines of force. This is the principle of the ordinary compass. The earth itself has a magnetic field which runs approximately north and south, and at any one point is practically uniform; so that a small bar magnet mounted at its center on a pivot to form a compass will, if left to itself, rotate until it is parallel to the lines of force in the earth's field and points approximately north and south. The reason why a magnet, after having become parallel to the field, will not rotate further is that the forces acting on its two poles pass through its axis and therefore have no turning effort. Further, if the field is perfectly uniform, the forces of attraction and repulsion are equal and opposite and therefore they balance each other and there is no tendency for the magnet to move laterally. Otherwise if nothing got in the way, all our magnets would migrate to the north pole, just as small particles of iron are attracted by an ordinary magnet. The reason for this attraction of small particles by a magnet is another matter. If you look at any of the figures representing the field of a magnet, you will see that this field is not uniform, for near the magnet the lines are more concentrated and farther away there is a tendency for them to spread out; therefore not so much force acts on a given point here as nearer to the magnet. If a small particle of iron be placed in this field, it first becomes magnetized and turns parallel to the lines of force, as in Fig. 21B; then since more lines of force act on the near end than on the far end, the force of attraction is greater than the force of repulsion, and the particle travels toward the magnet. It will be noticed that iron filings always collect the thickest on the corners of a magnet where the field diverges quickly and therefore is the most non-uniform. If the magnet is pointed, the field diverges still quicker and this makes an excellent article for attracting small steel particles, as for example, removing a sliver of steel from a workman's eye.

Electromagnetism

Up to the early part of the nineteenth century not much practical use had been made of electricity and magnetism. In the old days hermits and priests had looked wise while producing sparks from amber to the

mystification and alarm of spell-bound spectators, and later on philosophers with nothing else to do had amused themselves by playing with magnets, getting shocks from Leyden jars, and inventing lightning rods. Then about 1820 somebody started the train of discoveries that opened up the Electrical Age; a man named Oersted found that there is a very close relation between electricity and magnetism. He noticed that if a current be sent through a conductor in the neighborhood of a compass needle, the needle will be deflected, the amount of de-

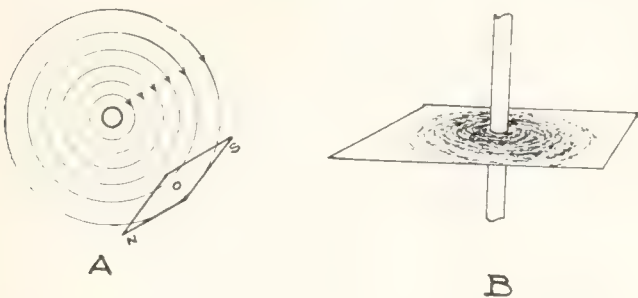


Fig. 22

flection depending upon the closeness of the needle to the conductor and upon the strength of the current; the direction of the deflection depending upon the direction of the current. If the current in the conductor is running from south to north, and the compass is placed above it, the north pole of the compass will be deflected toward the east; if the compass is below the conductor, the north pole will be deflected toward the west. With the conductor perpendicular to the plane of the compass needle, the latter will set itself at right angles with the wire, as shown in Fig. 22A. If a perpendicular conductor be run through a card and iron filings sprinkled on the card, they will arrange themselves in circles concentric with the conductor as in Fig. 22B. These experiments show that there is a magnetic field around every conductor carrying a current, that the magnetic lines of force travel in circles which are concentric with the conductor, and that they lie in planes perpendicular to the conductor. Moreover, the deflections of the compass show the relation between the direction of the current and the direction in which the magnetic lines move. This relation has been formulated into an expression known as the Right Hand Rule. If the thumb of the right hand points in the direction of motion of the current, the clenched fingers point in the direction of motion of the magnetic lines of force.

If a conductor be run through a card and between the poles of two magnets, and iron filings are shaken on the card, the result will look something like Fig. 23A. By examining this figure rather closely, you will see that the lines of force coming from the left hand pole instead of going directly over to the other pole, are deflected from their path by the field of the conductor and go up and around the conductor, coming down on the other side. You will see also that instead of the lines around the conductor being circles, they have been stretched downward to form ovals, with the conductor in the upper end. Referring to Fig. 23C, let X represent a conductor with its field and Y a uniform field from a magnet. When the conductor is placed in the field Y as in Fig. 23D, there is a straining of both magnetic fields. On the side where the directions of the fields coincide, there is a concentration of the lines of force and on the other side, where the fields oppose each other, there will be fewer lines of force. In other words, where the two fields coincide, there is a strengthening of the field, and where they oppose each other,

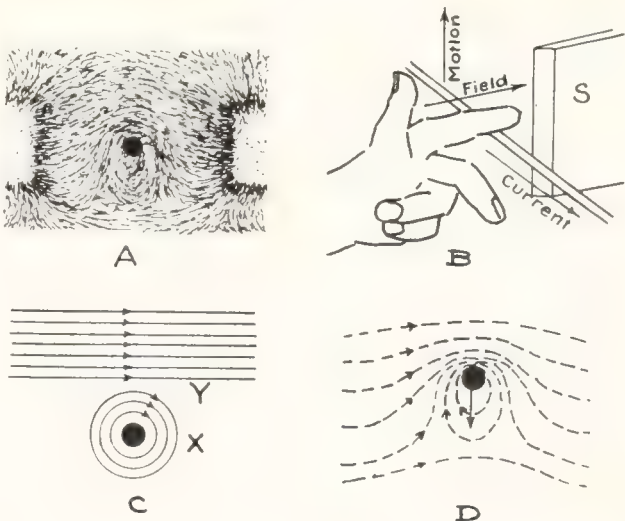


Fig. 23

the result is a weakened field. The lines of force stretched above the wire have a tendency to contract into their natural positions and the effect is the same as if the lines were stretched rubber bands; there is a side push on the conductor tending to drive it out of the field. As the conductor moves it cuts the lines in front, which then wrap around it and push it farther ahead.

The Motor Rule

There is another rule regarding the direction of this push, called the Motor Rule: If the forefinger of the left hand be held ex-

tended in the direction of the magnetic field, and the middle finger points in the direction of the current, the direction of the outstretched thumb shows the direction of the resultant force acting upon the conductor. Fig. 23B illustrates this. Considering, as above, a straight wire carrying current at right angles to a uniform field, the push on the wire is of course proportional to the length of the wire in the field, the strength of the current, and the strength of the field. A wire is said to carry a current of one c.g.s. unit (metric system) when 1 centimeter of the wire is pushed sidewise with a force of one dyne (a dyne is $1/980$ of the force required to lift a gram weight at a uniform rate) when the wire is stretched across a magnetic field of which the intensity H is one c.g.s. unit. The ampere is $1/10$ of this absolute c.g.s. unit. Work is the product of a force times the distance through which it acts. Thus if it takes a force of 5 lb. to move a certain load and the load is pushed a distance of 100 ft., then 500 ft.-lb. of work have been accomplished. A wire with a current running through it and placed in a magnetic field has a force exerted upon it and this force is capable of pushing the wire through a certain distance; so we see that with a current running through a wire we have performed work and with an arrangement of this kind it is thus possible to transform electrical energy into mechanical energy.

Suppose a wire loop to be arranged free to move on the end of a silk thread, as in Fig. 24A, the groove into which the outer end of the loop dips and the depression in the center being filled with mercury, so that it is possible to send a current through the loop and yet have it free to rotate. When the current is sent through, the loop rotates until its plane points east and west. This is because, as shown in Fig. 24B, the side from which the lines emerge, as determined by the Right Hand Rule, constitutes a north pole and the other side a south pole, or in other words the loop acts like a very short magnet and its poles tend to point north and south. A compass needle placed at the center of a loop carrying current will be deflected, and the tangent of the angle through which it is deflected is proportional to the amount of current flowing through the loop. This constitutes the tangent galvanometer, sometimes used by physicists for measuring current. A loop carrying a cur-

rent and placed in any magnetic field will always tend to rotate until its plane is perpendicular to the lines of force in the magnetic field, or so that its own field is parallel to the other field. If the current is quite heavy and the magnetic field strong, this turning effort becomes quite powerful. This is the principle of the electric motor, to be taken up later on. If a series of these loops be formed into a helix, as in Fig. 24C, the field produced is quite uniform except near the ends and its strength is proportional to the number of turns and to the strength of the current flowing through them. The product of the number of turns and the number of amperes flowing through them is called the "ampere-turns" of the coil and an ampere-turn will always produce a definite intensity of field at the center, so that the magnetic strength of a coil is customarily spoken of in terms of ampere-turns.

The Right Hand Rule

To determine the direction of the field, we may state the Right Hand Rule in a dif-

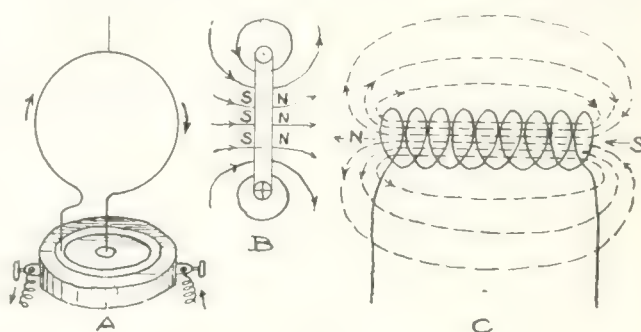


Fig. 24

ferent way: If the fingers of the clenched right hand point in the direction in which the current is flowing around the helix, the thumb points in the direction of the north pole of the helix. If a core of soft iron be placed in the helix, the strength of the combination is much greater than of the helix alone. This is because the core is magnetized by induction from the helix in the same way as we saw previously that a piece of iron can be magnetized by induction from a permanent magnet. The strength of the field produced by the magnetized iron is given by the expression seen before, $B = uH$, where B is the flux density, u is the permeability of the iron, and H is the intensity of the field produced by the helix, whose strength is proportional to the number of ampere-turns. The strength of the combination of helix and core is equal to the sum of the strengths of both, and inasmuch

as the permeability of very soft iron is thousands of times as much as that of air, as we saw before, the increase in strength gained simply by adding an iron core, is very great. It must be noted, however, that the permeability of the iron core does not remain at this high figure, but gets lower and lower as the flux density through the iron is increased and gradually approaches unity as the "saturation point" of the iron is reached, and if the magnetizing force of the coil is increased beyond this point, the increase in the flux density is merely that produced by the increase in the number of ampere-turns. Such an arrangement of a coil with an iron core is called an electromagnet and is used in practically every case where we wish to turn electrical energy into mechanical energy. Large electromagnets attached to cranes are used for lifting very large quantities of iron and steel and this idea is sometimes applied on a very much smaller scale in the plating room for fishing out iron articles that have fallen to the bottom of the plating tank.

Plumbers' Red Brass—A Criticism

Editor Brass World—I cannot entirely agree with the writer of the article in the August, 1915, issue of the BRASS WORLD, entitled "Mixed Metals—Plumbers' Red Brass." The statement is made that the alloy given is used in situations where neither strength nor toughness is required. Owing to the hard usage and wear that plumbing and steam brass goods are subjected to, and the constant water and steam pressures ranging from 40 to 250 lb., the leading manufacturers of this line of goods are improving the quality of the metals which they use.

Any person with a knowledge of alloys has only to glance at the rough or unfinished surface of plumbing castings made by the leading concerns to note by the color the quality of the metal used in the castings. The mixture generally used follows:

Copper	85.00 per cent
Zinc	6.00 per cent
Lead	4.00 per cent
Tin	5.00 per cent

This produces what is known commercially as red brass. The mixture just given might with propriety be called a bronze composition as it does not differ materially from the bronze formula given by

Hiorns, the English authority, which is as follows:

Copper	84.00 per cent
Tin	2.9 per cent
Lead	4.8 per cent
Zinc	8.3 per cent

The high grade red brass (plumbers' brass) goods on the market to-day are pleasing to the eye in either a rough or a finished condition. The metal is close grained and tenacious, and in tensile strength is far superior to the yellow brass alloys used by plumbers in the past. There is an absence of the cheap, brassy appearance of the castings in which zinc is used in large quantities.

Yours very truly,
P. W. BLAIR.

Sarnia, Ont.

(Comment.—While we greatly appreciate the criticism of Mr. Blair, and the formulas he has given, we wish to point out that the mixture presented in the article on red brass was not intended for use in high grade plumbers' brass goods, but for situations "where neither great strength nor toughness is required," and in this connection it may be remarked that the alloy given is being extensively used by the trade, and seems to be satisfactory in the field which it covers.—The Editor.)

The Work Done by a Cartridge

The cartridge used in the German infantry rifle, marked M 98, contains 3.2 grammes, or about 0.112 ounces avoirdupois of powder, which on explosion creates 2762 calories, or 10,960 B.t.u., corresponding to 1170 kilogramme-meters, or 8463 foot-pounds. Of this one-third is utilized in creating the initial velocity of the bullet of 820 meters, or about 2690 ft. per second, and in imparting the rotative motion. One-quarter of the energy is lost in heat to the barrel and 45 per cent passes away in sound energy and the escaping gases. The bullet passes out of the barrel in 1/200 of a second, and during this time a pressure of 5600 atmospheres, or 51,450 pounds per square inch is acting within the barrel.

A good alloy for casting pattern letters and figures, and similar small parts, in brass, iron, or plaster molds, is made of lead, 70 parts, and 15 parts each of antimony and bismuth. To make perfect work the molds should be quite hot.

NOVEL METHOD OF MAKING MOLDS FOR DIE-CASTING NAMEPLATES

In describing the method of manufacturing nameplates for machinery, developed by the Federal Nameplate and Novelty Co. of Chicago in a recent issue of *Machinery*, Edward K. Hammond states that the nameplates are die cast, each letter, figure, or unit of decoration or background being made in a separate block of steel, which is carefully ground on all sides to fit accurately together so that all can be locked up in a frame to form the mold matrix from which the plates are cast, after which the mold is broken up and the sections are distributed to the different "fonts," or cases, in which they are kept.

While a considerable stock of these "types" are kept on hand it occasionally happens that new letters or designs are required for some special form of nameplate and have to be made for the occasion, the method of procedure being as follows. A master punch or "hub" is first made for each letter or figure in the required nameplate, and after these have been completed the mold sections are produced by forcing the master punches into the ends of accurately finished steel blocks by hydraulic pressure. The tool steel blocks from which the mold sections are made are finished to approximately the required size before the impressions are made in them, and after this operation has been performed all sides of the blocks are accurately ground to size so that they will fit together properly.

After this has been done the mold sections are locked in a frame, Fig. 1, which is closed to form the mold by means of a plain steel plate which forms the back of the nameplate when cast. The mold then goes to the die-casting room where it is set up in the machine ready for casting the required number of nameplates.

Having made this preliminary statement, remarks the author, we can proceed with a detailed description of the different operations involved in making the mold, which are as follows:

In making the hubs or master punches, the first step is to prepare the tool steel blanks, one of which is shown in Fig. 2. The blank is at first accurately ground so that the sides *A* and *B*, Fig. 2, are exactly at right angles to each other, these sides being

used for the purpose of locating the blank in the different fixtures in which it is held while being engraved.

After the sides have been ground in this manner, the face of the blank in which the letter is to be sunk, is ground perfectly smooth and square with the sides *A*, *B*, after which it is polished on a lapping plate charged with emery flour in order to obtain the necessary smooth surface on which to lay out the letter.

In laying out the work there are two alternatives: The engraver may be called upon to reproduce a master punch which has been damaged, or he may be required to lay out a new letter of a specified size, requiring a different method of procedure in each case.

The method of reproducing a master punch that has been damaged is as follows: The block which has been finished in the

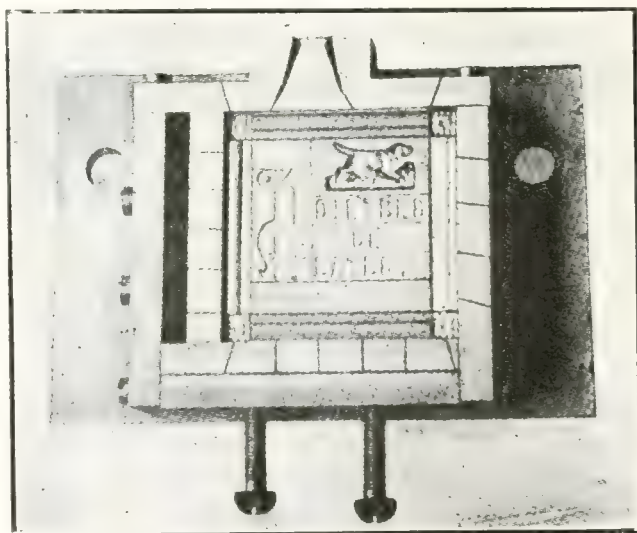


Fig. 1—Assembled Mold with Back Plate Removed to Show Matrix

manner just described is clamped in one socket of a double jointer, and the block on which the letter is to be laid out is secured in the other socket of this tool. This double jointer is merely a duplex clamp which provides for holding the work and the master which it is desired to reproduce. The socket in which the work is held may be adjusted by means of two screws, one of which regulates its lateral position and the other its angular position, so that the block is lined up with the master that is being worked from. After these adjustments

have been made the engraver uses a square angle gage to locate the required points on the work from the master which is held in the other socket of the double jointer. When these points have been located, the letter is laid out and the work is ready to be engraved.

A special routing machine is used for this

purpose, the head of which is provided with the usual form of micrometer stop for regulating the depth to which the work is engraved, and the vise is provided with a special form of micrometer collar for locating the work for engraving along angular lines, such as the cross bar of the letter Z, Fig. 2.

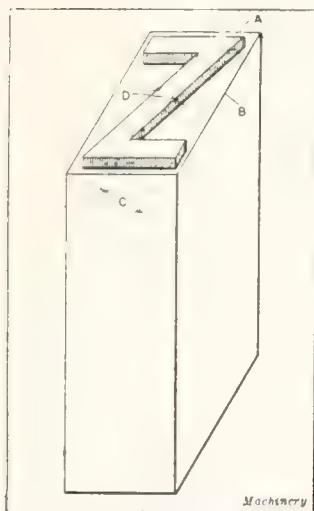


Fig. 2—Master Punch, or Hub, for Letter Z

For making this setting the engraver uses his micrometer gage to measure the distance C, on the master shown in Fig. 2 from which he is working; or on the letter which he has laid out on the work, should he be laying out a letter from dimensions. He will then swivel the vise on the engraving machine through a corresponding distance. This results in bringing the cross bar on the letter parallel with the cross slide on the engraving machine, and it is then an easy matter to run the routing tool along the required lines.

After the routing is completed, the en-



Fig. 3—Hubs for Small Letters, Figures, Backgrounds, Borders, etc.

graving is finished by means of hand gravers, and as the engraver uses a watchmaker's glass, he is able to attain an extremely high degree of accuracy.

When the engraving is finished, its accuracy must be proved, which is accomplished by measuring the "weight" or thick-

ness of the lines, the depth to which the letter, which is to be compared with the the letter. This measurement is made by means of "ceriph" gages. These gages consist of two semicylindrical members which are sharply pointed at the ends. The two parts of the gage are pinned together in such a way that the two halves may be moved longitudinally in relation to each other. In using the ceriph gage, the operator first sets it so that the two points lie on opposite sides of the line on the master letter, which is to be compared with the line on the letter that has been engraved. This setting can be made with extreme ac-

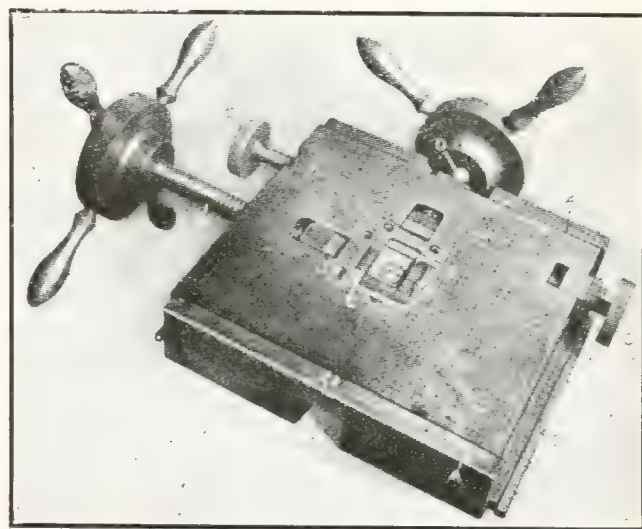


Fig. 4—Fixture Used for Holding Work While Forcing Hubs Into Mold Sections

curacy, as the points are quite sharp and the watchmaker's glass magnifies an error in setting which would be invisible to the naked eye. After the ceriph gage has been set from the master punch, it is used to measure the accuracy of the corresponding line on the work. All of the lines are gone over in this way, and any errors are corrected.

The next step consists in measuring the "counter" of the letter. The counter of a letter is its inside width, the counter of the letter Z, Fig. 2, being the distance indicated by D. This measurement is made with an instrument called a micrometer counter gage, which is a special micrometer caliper made with parallel knife edges which are accurately set on opposite sides of the counter by aid of the watchmaker's glass. After the accuracy of the counter has been determined, a lining gage is employed to determine the accuracy of the positions of

the "cap" line, the "descender" line, and the "side" or "set" line of the letter.

The "cap" line is the bottom line of the capital letter, or the line on which all of the letters rest. The "descender" line is the line marking the distance which the lower case letters *g*, *j*, *p*, *q* and *y* extend below the "cap" line. The "side" or "set" line is the distance of the right hand side of the letter from the side *B*, Fig. 2, of the block on which it is engraved. The accuracy of this dimension is a point of vital importance, as

The preceding description applies to the laying out of a master punch or hub from an existing master punch. When it is required to lay out a letter without the use of a master, the location of each point must be determined by the micrometer screws on the engraver's gages. The required size of the letter and weight of the lines will also be determined with these micrometer gages, and after the letter has been engraved its accuracy will be proved as described in the preceding paragraph, except that the gages



Fig. 5—Examples of Nameplates, showing Variety of Letters, Numbers, Backgrounds, Etc., That Can Be Used

all letters are located on their blocks from the side *B*, and the proper spacing of the letters is determined in this way.

All of the required dimensions have now been determined with the exception of the depth to which the letter has been engraved, and for this purpose what is known as a depth gage is employed. This is simply a refinement of the machinist's depth gage, and is used in about the same way, except that there is a sharp knife edge which comes into contact with the finished face of the work, and accuracy is proved by noting whether the knife edge is raised enough for light to pass underneath it.

will be set by means of the micrometer screws instead of setting the edges of the gages to the required faces on the master on which the work was laid out.

After the punch has thus been made and its accuracy proved, it is transferred to the hardening department, and after being hardened is ready for use in making the mold sections.

For the mold sections, blanks of commercial annealed tool steel are machined and ground to the approximate size required. These blanks are then mounted in the fixture shown in Fig. 3, which is carried on the bed of a hydraulic press that is used

to drive the hub down into the face of the blank to produce the required impression for the mold section. The fixture, Fig. 4, is provided with two slides *A* and *B*, which enable the longitudinal and transverse adjustments to be made, in order to locate the work in the proper position under the punch. The longitudinal movement of the fixture obtained by the slide *A*, is regulated by the screws *C*, while the transverse movement of the slide *B* is governed by a pair of screws carried by a plate secured to the bed of the press.

In addition to the means of making these adjustments, the fixture is provided with two backing-up screws *D*, Fig. 4, which hold hardened steel plates *E* against two sides of the work, and force the work against the two fixed sides of the socket in the fixture. In this way the blank is adequately supported on all sides so that it will not be distorted by the high pressure which is necessary to drive the punch down into the steel.

But to guard against slight distortions which may occur, the blanks are transferred from the press to a surface grinder, where they are held on a magnetic chuck and ground on all sides to reduce them to exactly the required size, and at the same time to eliminate any slight errors which may result from distortion during the formation of the depression under the hydraulic press.

In this grinding operation, care must be taken to have the sides of the blank ground exactly parallel and to have all blanks of exactly the same size, otherwise the different sections required for a finished mold would not fit together properly. Also, it is obviously necessary to have all of the mold sections of exactly the same height in order that they may be assembled with their working faces exactly level.

After the necessary mold sections have been made, they are assembled and locked together to produce a mold of the general form shown in Fig. 1. The mold is shown with the back plate removed to show the matrix; but this plate is merely a flat piece of steel which fits closely against the rim and forms the plain back of the nameplate. It will be seen that the rim at the top of the mold is gated to provide for the metal flowing into the mold, which is accomplished in the manner usual with die-casting operations.

The nameplates are made from two kinds of metal; plates to be bent are usually of a white metal that is sufficiently ductile to permit bending without danger of breaking. Where the plate is to be mounted on a flat surface, greater durability is obtained by casting the plates of a special brass mixture. Different methods of finishing are employed to add to the attractive appearance of the nameplates. In some cases, the Schoop process of spraying molten metal onto the surface of the plate is employed, and where this process is followed, the surface of the plate may be coated with copper, silver or other metals of distinctive color. In other cases, it is found desirable to electroplate the nameplates. After the metal coating has been applied, the plates are lacquered to give them the final finish.

It is often required to have the letters of one color and the background of another, and to secure this result the entire nameplate is sprayed with the colored lacquer which is required for the background. While the lacquer is still wet, the surface of the plate is wiped with a soft cloth which removes the lacquer from the faces of the raised letters, exposing the surface of the metal to give the letters the distinctive color of the metal from which the plate is made. Then after the first coat of lacquer is dry, the entire plate is again sprayed with white lacquer to give the final finish. The combination of different decorative effects, a border and an artistic background, in connection with the required lettering on a nameplate, naturally adds greatly to its appearance. The background may be of "basketwork" design, stippled, or of any other pattern required, or it may be left plain. When it is taken into consideration that these features are obtained by a method which enables nameplates to be made without any charge for engraving the mold, it will be evident that this process of die-casting in sectional molds is one which is destined to be of far-reaching importance to the mechanical public.

The copper produced from California ores in 1914 was 30,507,692 lb., valued at \$4,057,523, a decrease of 4,067,315 lb., in quantity, and \$1,301,603 in value. It is this deficit in value which accounts for the decrease in total value of the metallic output of the State in 1914.

SCUM AND METHODS ADOPTED TO OBTAIN A MINIMUM

By F. ANDREW*

The term scum is applied to that substance which appears on the upper surface of castings as dull patches in contrast to the cleaner and brighter portions. It is principally found in close proximity to the place where the metal enters the mould. This scum is distinct from mould dirt resulting from a scab, or loose sand left in the mould, and also from the scum which usually floats on the top of the shank or ladle. It is probably of a similar character to that which is constantly rising to the surface of the metal in the shank, but the distinction is given to prevent confusion between scum drawn down the runner, and scum formed in the mould by the cutting action and agi-

casting which is filled quickly and with the least agitation will show the least scum.

Similar difficulties occur with manganese-bronze, aluminum, aluminum-bronze, and other metals, and the remedy as applied to these is to get the metal into the mould as quietly as possible, in this way avoiding the exposure of several fresh surfaces of the molten metal to the atmosphere, and preventing excessive oxidation. This oxidation produces a film, excess of which, when accumulated, will produce a flaw, and cause the castings to leak when subjected to pressure tests. To obtain a quiet entry of the

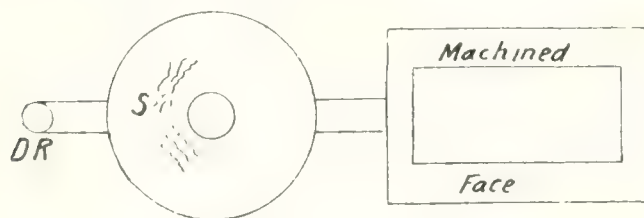


Fig. 1

tation of the metal as it enters. Various explanations are given for its appearance, but generally it is put down to bad skimming or mould-dirt, and though kish, or separated carbon, is sometimes suggested as the cause, the average foundry very seldom sees any of this substance, except in the pig-iron, generally in the sows and in very small quantities. The writer's contention is that no matter how clean the mould, or how well the metal is skimmed, there will always be

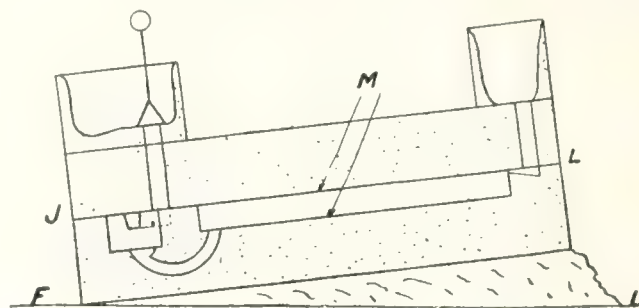


Fig. 2

metal into the mould, it is made to traverse long channels or gates before entering the mould proper, this overcoming the agitation caused by the fall from the runner-box to bottom of down-runner, the channels being provided with dummies or risers to take scum formed by this agitation, which, if the down-runner and in-runners are so proportioned as to be kept full, occurs only at the beginning of pouring.

If such methods were employed as far as

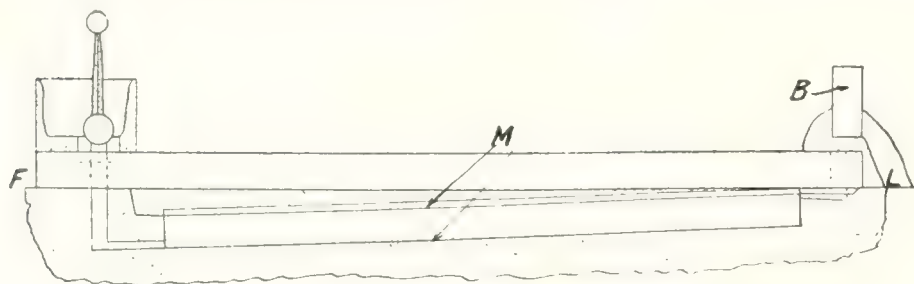


Fig. 3

this scum present unless the casting is small and filled immediately. The cause of excessive scum is the abnormal agitation of the metal by badly designed runners. The composition of the metal is also influential in its formation, but, given similar metal, that

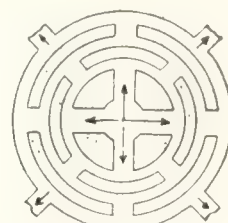


Fig. 6

practicable in the iron foundry, when making castings requiring freedom from scum on the upper surface, success would be more frequent, and as a result the excessive allowance often made for machining, to get below the scum, could be dispensed with, to the advantage of the life of wearing

*Foundry Trade Journal.

parts of machinery and decreased cost of metal.

A moulder when making more than one casting in a box often cannot put a separate down-runner to each casting, and frequently runs one casting out of the other, the casting of least importance receiving the first metal being supposed to act as a skimming gate. The real purpose served is the checking of the agitation and rushing of the metal; the latter rises steadily in the

good one, as the small amount of slant would not be sufficiently effective to allow dirt or scum to rise, and such scum would have a tendency to cling to the surface, with no great force behind it, this even occurring on the vertical sides of moulds occasionally; the second reason appears to be nearer the truth, but there is also another, viz., that the metal rises quietly without rushing, the first metal preventing the rush of that which follows, the whole rising

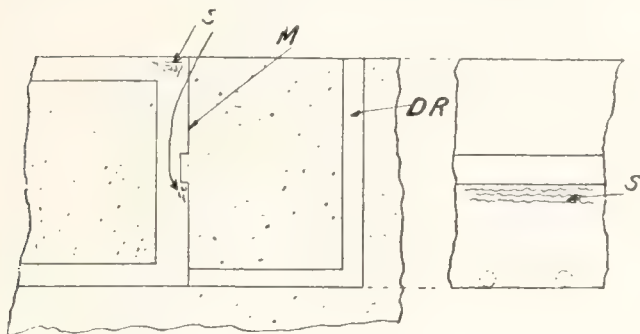


Fig. 4

mould furthest from the down-runner, oxidation being confined to the upper surface and forming a thin film, which protects the metal below, and remains at the top, so thin as to be no detriment to the casting.

In making tables for planing machines it is the practice of at least one shop to lay the pattern on a bed with a slight slant, the gates supplying the metal being fitted at the

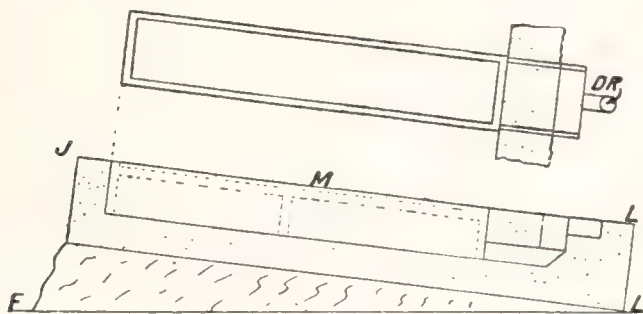


Fig. 7

lowest end. The amount of slope is about 1 in 30. The joint on which the top box rests is level, causing a lift gradually increasing in depth as the runner-end is approached. One reason given for slanting the bed is that any dirt entering, or already in the mould, will rise to the higher part of the mould and escape through large risers prepared for it at the upper end in the joint, sometimes almost the width of the casting. Another is that there is less tendency to scab near the runners than where the metal is constantly dashing over one part for a comparatively long period till the bottom is covered. The first reason is not a

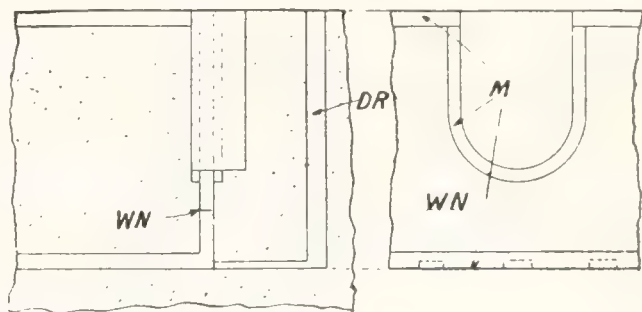


Fig. 5

gradually. In flat pouring a mark may be caused by a quantity of metal rushing in one direction and cooling somewhat, so that when more metal enters it will not unite with it and actually leaves a joint in the metal. In the case of beds having large oil trays on the side this may cause a hole, due to metal coming in at two different positions on the tray, and encircling a quantity of air which is unable to escape before the

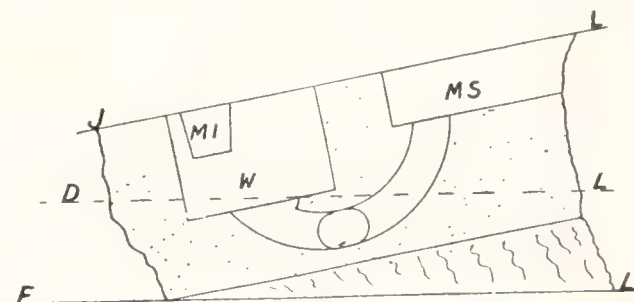


Fig. 8

metal solidifies. This, does not occur pouring mould inclined.

Granted that a mould is clean and capable of standing the heat of the metal, and that a deep runner-box provided with stops is used, where can the scum (which is always present in greater or smaller quantity) come from if not from the oxidation of the metal by exposure through agitation? Certainly, if the mould is not sufficiently refractory to stand the heat, any part on which the metal is constantly playing will show a roughness, with a corresponding amount of dirt in some other part of the casting.

Wherever possible the bad effects of the scum are avoided by casting work with the face down which has to be machined; but when this is not possible, due to upper and lower faces being machined, the places where the scum is most likely to be formed (near the runner) are studded closely with sprigs which project almost across the wall of metal, and these serve to hold the scum while the metal rises. It is obvious that this method will not apply where castings are subjected to pressure tests or are machined up the sides, and in such cases hot metal and extra thicknesses on the upper face are the remedies applied.

This scum is found in all castings of any size, principally under projecting parts of the mould, and may many times not be visible till machined at that part.

Figs. 1 to 8 are examples of methods previously referred to, all more or less effective in producing a minimum of scum or retaining it in less important parts of the casting. Fig. 1 shows a small slide valve for a steam engine cast with machined face uppermost and run out of an unimportant casting, a plain flange, which retains the greater part of the scum in the part marked *S*. Fig. 2 shows the method adopted for casting a flat disc about 250 lb. in weight, machined all over, having also to stand a high pressure test. The moulding box is laid on a slanting bed. Fig. 3 shows the method of casting a planing-machine bed, vees uppermost, weight about 2500 lb. Fig. 4 shows two views of the end of the mould for a large bed-plate about 20,000 lb. in weight, with the position of the runners and the position of the scum in almost every casting, as at *S*, especially under the sand projection running along the end of the bed. In this case the better plan would be to cast the end plain, as shown by dotted line, and thus allow the scum to rise to the top, where its presence is of less importance.

Fig. 5 shows the method of placing wire nails (*WN*) in a core and projecting across the wall of metal to hold the scum rising from the flat runners below, and prevent its reaching the U-shaped facing above; weight about 16,000 lb. Fig. 6 shows an arrangement of runners to run four small castings about 6 lb. in weight each. This method looks rather complicated, but has proved most successful after trying almost every kind of skimming-gate, the castings

requiring to be very clean. The reason for the success in this case is the effect which the tortuous channels have in steadying the metal, which enters at the center and leaves finally as shown by the arrow-heads to the castings. Fig. 7 shows a small box rail machined on all sides and on the narrow facing running around the top. The plan depicts the part of the mould over the runners taken away, to show the position of the in-runners relative to the well of the runner; weight 200 lb.

Fig. 8 is an enlarged section of the runner used in Fig. 2. The metal enters the well *W* by metal inlet *MI*, and almost immediately fills the bottom of the horn-shaped runner of oval section. When the metal reaches the height of the dotted line *DL* skimming becomes unnecessary, as no dirt entering by metal inlet *MI* can pass into the mould, but merely floats in the well, which never drains, even should pouring be stopped for a time, and the clean metal rises with a minimum of agitation and fills the mould.

Tariff on Copper-Zinc Ore

A decision has been handed down interpreting the ore provisions of the tariff act of 1913 that is important to smelting interests.

A company imported copper ore containing zinc varying from 3.60 to 7.30 per cent. Duty was levied on the zinc content at the rate of 10 per cent—upon an appraised valuation thereof at 4c. per lb.—under the provisions of paragraph 162. The importer went before the lower customs tribunal with the claim that the ore is properly entitled to free entry under paragraph 461 on the ground that the quantity of zinc contained therein is negligible and not capable of being recovered or used. Counsel for the Government asked that the collector's assessment be affirmed by the board on two grounds—that inasmuch as the zinc content was appraised at 4c. per lb., it cannot now be held to be of no commercial value, and that the provisions of paragraph 162 were intended to apply to and cover the zinc content as found in the ore in its imported condition, without reference to the quantity thereof which may or may not be determined to be commercially recoverable.

"Keep your eye on Brass World."

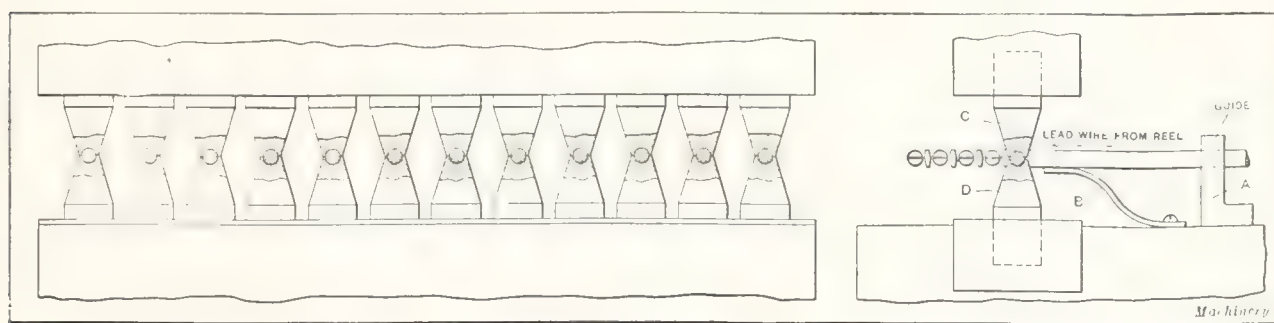
Making Shrapnel Bullets

The most deadly and effective parts of a shrapnel are the lead bullets which are held in the shell. When the timing fuse explodes the powder in the base of the shell the nose is blown off and the bullets are thrown out in a cone shape. The range covered by these bullets in an 18-pounder shrapnel shell is about 250 sq. yd. The lead bullets, which in most shrapnel are $\frac{1}{2}$ in. in diameter, are made from several different compositions, but consist chiefly of 87.5 per cent lead and 12.5 per cent antimony. The number of bullets carried in the shells by various governments varies; in the American 15-lb. shell there are 252; in the British, 235 or 236. The bullets used by the United States Government have six flattened sides to facilitate packing, whereas those used by foreign governments are spherical.

Two of the several methods of making shrapnel bullets are in use at the present

which it is extruded through a die by a plunger advanced into the cylinder. By this method it is necessary to allow the metal to settle before the press can operate. An improvement over this is utilized in presses built by a hydraulic lead press manufacturer of Brooklyn, and consists in first casting ingots of the required diameter and length and then charging the press with these instead of pouring the molten lead into the press chamber. Two presses have been designed for this process. One has a capacity of 700 tons and is charged with ingots weighing 150 lb., whereas the other has a 900-ton capacity and is charged with 200-lb. ingots. The product from these two machines is 1800 lb. of lead wire from the small and 2500 lb. from the large press per hour. The wire as it is extruded from the die is wound on a reel carrying 2000 lb. of wire.

There are two principal types of swaging



Swaging Machine for Making Shrapnel Bullets

time. One is to cast the bullets in iron molds; another is to cut off slugs from lead wire and strike these between dies in a heading machine. The bullet heading machine takes the wire from a reel, cuts it off, forms it and trims off the resultant flash automatically. In making the American bullet a second operation is necessary to flatten the sides. In making flattened bullets one hydraulic wire-extruding press and fourteen heading machines are capable of giving a production of 850 bullets per minute. For the spherical bullet one hydraulic press and eight heading machines produce 950 bullets per minute. The method of casting lead bullets is antiquated to a certain extent and another method somewhat similar to that described has taken its place. The first step is to produce the wire from which the bullets are eventually made. This is accomplished in two ways. The first is the hot metal process and consist in pouring the molten lead into a cylinder, from

machines used for making these lead bullets from wire. One carries a single set of dies, whereas the other carries twelve sets of tools. The operation of the latter will be described. Referring to the diagram, twelve reels of lead wire—not shown—are arranged in tandem on stands behind the press, six reels in a row. The wire is conveyed from these reels to the dies by a feeding mechanism, being guided to the individual tools by a plate A, having twelve U-shaped impressions in its top edge. The wire now passes over a spring B which serves to lift it up slightly at each stroke of the press. The tools C and D, as shown, are provided with half-spherical depressions in their adjacent faces and are set so that they come within $\frac{1}{64}$ in. of meeting. The dies are guided and controlled in action by a special mechanism, and the press in which they are carried operates at 70 r.p.m. This gives a rated production of 840 bullets per minute. As is clearly indicated in the illus-

tration, considerable scrap is formed in making lead bullets by this process—in fact, the scrap is about 33 per cent of the reel of wire; also owing to the setting of the punches a slight fin is formed around the periphery of the bullet, which is removed in a subsequent operation.

After forming, the bullets are taken to a tumbling machine, where they are tumbled for one hour. No other material is put into the tumbling barrel, but the action of the bullets working on themselves satisfactorily removes all the fins. Both the swaging and tumbling operations must be carefully watched because of the necessity of having the bullets a certain weight. The allowable variation on one pound of bullets is one dram, and there are forty-one bullets to the pound. Ten pounds of lead rod make 6½ lb. of bullets, and the scrap resulting from the swaging operation is remelted and used over again. After tumbling, the bullets are inspected and are then ready for use.—*Machinery*, April, 1915.

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The high price of copper, which has prevailed for some time, has resulted somewhat directly in the redesigning of electric switches, so that steel now predominates in their construction with no loss of efficiency, it is claimed by the various Hartford manufacturers who specialize on this product.

Clothing in the Foundry

In foundries a great hazard lies in the handling of molten metal. Protection from this, as well as from other risks, can be obtained to a large extent by the use of proper clothing.

Burns of the feet and legs are the most frequent accidents; to avoid them, special foundry shoes of the Congress type should be worn, and these should be made of leather selected to withstand heat and dampness, should have a sole tapered at the edges to allow spilled metal to slide off, and should be fitted with high-class elastic goring that will keep the tops always snug and exclude molten metal. Leggings should also be worn; these are preferably of canvas, secured over spring clips so as to give a smooth outside while being easily pulled off. Asbestos leggings cost more, are heavier and less comfortable, but may be required in special cases. Woolen trousers catch fire less readily than cotton, but

cotton jeans shed molten metal well; thin cotton, however, is dangerous.

Gloves are required as protection against heat in many cases, heavy leather gloves being usually sufficient, although some conditions may demand asbestos. For handling rough or hot metal, handleathers may be superior to gloves; they are often home-made of scrap leather or heavy canvas, and consist of a piece on each side of the hand frequently fastened at the wrist by elastic goring; they give freer movement of the fingers than do gloves, but the latter afford better protection against heat or cold.

To guard the eyes against splashed metal, chips from cleaning or grinding, and the heat and glare from oxy-acetylene or electric-arc welding, goggles are necessary. Open-hearth furnacemen require goggles with cobalt-blue lenses to enable them to watch the metal, while obtaining protection. Oxy-acetylene welders' goggles have lenses of a dark green shade, but for the more intense heat and glare from electric-arc welding, dense lenses are required made of several thicknesses of blue and red or other colored glass, and set in a helmet. Goggles should fit snugly but comfortably, and the lenses should be ground on both sides, so as not to injure the vision, and should be fairly well matched in thickness and color.—*N. F. A. Safety Bulletin*.

Aluminum and Bauxite in 1914

The Geological Survey reports that the quantity of aluminum consumed in the United States in 1914 was 79,129,000 lb., against 72,379,000 lb. in 1913 and 65,607,000 lb. in 1912. The value of the exports of aluminum and of manufactures of aluminum amounted to \$1,546,510 in 1914, as compared with \$966,094 in 1913. The quantity of crude and scrap aluminum imported in 1914 was 16,241,340 lb., against 23,185,775 lb. in 1913. In addition manufactures of aluminum valued at \$1,308,036 were imported in 1914, an increase of \$217,807 over the previous year.

The production of bauxite in 1914 was 219,318 long tons, an increase of 9077 tons over 1913, and the largest quantity ever reported.

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“I have taken your paper more than ten years and I recommend it highly to all electroplaters and manufacturers.”—Charles Essex, Troy, Ohio.

AN ELECTRIC FURNACE FOR SMELTING GOLD SLAGS

By W. P. LASS.

The gold precipitate from the zinc-dust presses in the cyanide plant of the Alaska-Treadwell Gold Mining Co., Treadwell, Alaska, is treated, in the refinery adjoining, by the Tavener or lead-smelting method. About 3 or 4 tons of this precipitate is produced monthly having a gold assay value of \$40,000 to \$60,000 per ton.

It was formerly the practice to treat the by-products from this process, consisting of 2 tons of slag, 300 lbs. of matte, 500 lbs. of refinery refuse, flue dust, etc., in a 24-in. water-jacketed blast furnace. This practice was discontinued in the summer of 1914 by reason of the difficulty of keeping the lead-well open when treating a high-grade lead product; of preventing the loss of gold in the flue dust; and of avoiding injury to the general health of the refinery operators; a plain single-phased electric furnace was substituted for the blast furnace.

The furnace was constructed from an old steel acid drum by cutting off the top and introducing a cable, made from strands of bare copper wire, through the bottom and spreading the strands out fan-shaped on the inside of the drum.

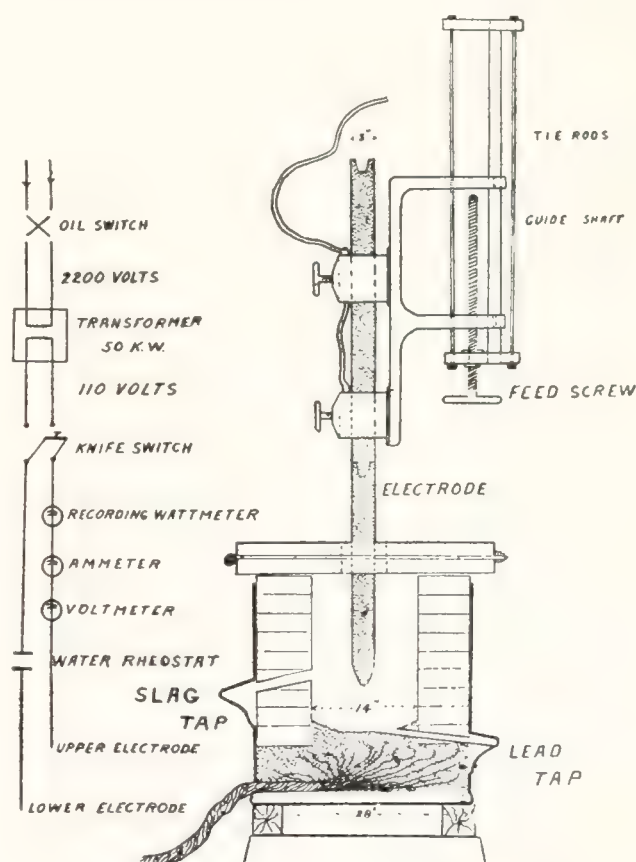
Powdered graphite, obtained by grinding up old crucibles, mixed with 10 per cent. cement, was tamped wet into the bottom of the drum, around and completely covering the copper wires. The graphite was carried up to the bottom of the furnace, or lead-well, and acted as the lower electrode. The sides were built up of ordinary fire brick forming a melting chamber 14 in. in diameter by 20 in. high.

The upper electrodes, of graphite or carbon, are 3 in. in diameter and 40 in. long, arranged with joints enabling new electrodes to be connected without shutting down or wasting stubs. A screw feed was arranged for raising and lowering the upper electrode. (Fig. 1.)

The cover for the furnace had three openings, one for feeding the charge, one for the escape of gases, and one in the center for the introduction of the electrode. It was later found more practical to enlarge this center opening to 6 in. in diameter, to allow of a central feeding of the charge around the electrode. A 4-in. pipe con-

nected to a ventilating fan carries off the escaping gases. The furnace is operated on the lighting circuit through a 50-kw. transformer, 60 cycles, 110 volts.

Later, a water rheostat, operated by raising and lowering one disk on another submerged in a barrel of water, was constructed to lower the voltage for use when starting the furnace, or when there was a bath of metal in the bottom of the furnace that would otherwise allow too much cur-



Sectional View of Electric Furnace

rent to pass and thereby cause short circuiting.

The material to be treated in the furnace is mixed in the following proportions: Refinery by-products, 100 lbs., old reverberatory hearths, containing 60 per cent CaO , 20 lb.; litharge, 20 lb.; coke, 2 lb.; scrap iron, 3 lb. About 160 lb. of the mixture is added for a charge. The total amount of material added during the melt is 8507 lb. of which 5870 lb. is by-product material (old slag, the residue from burning old mill launders, sweepings, etc.) of the following composition:

	Per Cent
SiO ₂	40.1
Fe	16.0
CaO	16.1
Cu	5.9
Pb	3.0
Zn	5.7
Al ₂ O ₃	2.0
S	3.6
Moisture	4.0
	96.4
Gold	\$1,096.60 per ton

Coke is added to the charge as a reducing agent, only a quantity sufficient to throw down the lead being used. The charge is introduced into the top of the furnace through the central opening around the electrode without removing the slab cover.

In starting, the furnace is operated as an arc furnace, until it has become thoroughly hot, when the charge, consisting of slag, brick dust, etc., is added, the electrodes being raised as the load in amperes increases, until the entire chamber is filled with the charge and the upper electrode extends into the melt almost a foot. As the charge continues to melt the electrode is moved down or up, keeping the amperage reading as nearly constant as possible. The raising or lowering of the upper electrode decreases or increases the power consumption and thereby affects the amount of heat generated.

At this stage the furnace is no longer operating as a simple arc furnace, but has automatically transformed itself into a resistance type of furnace, the semi-fluid or molten charge acting as the resistant, the current passing from one electrode through the center of the charge to the other.

After the charge is in quiet fusion, which takes on an average 2 hr. 10 min., the power is turned off and the charge allowed to settle for 15 min. before tapping the slag. This allows the lead to settle out, the furnace acting as a forehearth.

In operation, the molten lead and slag are tapped, as in the blast furnace. If the lead freezes it is melted by diverting current from the upper electrode and letting it pass through the lead, the tapping rod playing as an arc on the side of the furnace or into the lead tap. The operators use colored or amber glasses to protect

their eyes from the glare of the electric arc.

Total running time, 128 hr. 40 min.
Average weight of charge added, 160.5.
Average fusion time of charge, 2 hr. 25 min.
Total number of charges, 53.
Graphite electrodes used, 1 per 24 hr.
Total power for 128 hr. 40 min., kw.-hr., 4440.
Power used per hour, kw. 34.50.
Power used per pound of material fed, kw.-hr., 0.52.
Power used per ton of material fed, kw.-hr., 1044.
Acheson graphite used per hour, ft., 0.15.
Material melted per hour, lb., 67.7.
Material melted for 24 hr., lb., 1625.

The only item of cost for flux is the coke, 2 lb. per 100 lb. of by-product material or 118 lb. total being used, since the old reverberatory hearths furnish the lime; the cupels from bullion refining, the litharge, and mill scrap, the iron.

Both graphite and carbon electrodes are used, the former costing \$2.95 each, and the latter \$1.20. Power cost is less than 1 ct. per kw.hr.

The labor required for the operation of the furnace, including the work of charging and tapping, is one-half one man's time, when melting 1 ton in 24 hr.

The furnace was constructed and put into operation by the regular cyanide-plant crew, without the aid of special electricians. The operation is so simple as to require no special training. Although the operators were unaccustomed to handling electrical equipment, no trouble has been experienced from electrical shocks, since the bottom of the furnace acts as the lower electrode, or grounded circuit.

The advantages of the electric furnace compared to the blast furnace for melting high-grade gold slags are: A saving in mechanical loss of gold in flue dust, because the melting is done in a quiet neutral atmosphere, instead of in a rising blast of air; the obtaining of a lower-grade slag, free from shot, by reason of the quieter melting action and the higher temperature obtainable, making a more fluid slag; the nicety of regulation of the melting temperature; the benefit to the general health of the operators.—*Mining & Engineering World.*

It is the intangible factors entering into production cost, such as light, ventilation, heat, crowded machinery, elevator service, cheerful surroundings, etc., that are the most difficult to account for and to take into consideration properly.

QUESTIONS AND ANSWERS

All communications under this head should be addressed to the "Questions and Answers Editor"

The Cause of the Nickel Peeling

QUESTION No. 75.—My brass work is perfectly free from grease, but still the nickel peels off. My silver has dark streaks. What is the reason?

ANSWER.—The reason the nickel peeled from the brass, even though the brass was free from grease, was that the brass surface was tarnished or oxidized. After removing the grease, all brass work to be nickeled must be dipped in a cyanide wash or in a 1 to 4 oil of vitriol pickle to remove the oxidation before the work is hung in the nickel solution. The streaks on the silver are caused by a too heavy current.

Use Regular Steel Clamp Molds

QUESTION No. 83.—How can I get in permanent molds small silver castings similar to knife handles, for instance?

ANSWER.—Use the regular steel clamp molds brushed with graphite or bone black.

Oxidizing Nickel

QUESTION No. 85.—Can nickel be oxidized, and if so, how? Also would like formula for French gray that can be produced on anything without silver plating.

ANSWER.—The cheapest and most satisfactory method of oxidizing nickel is to make a nickel solution, then add $\frac{1}{2}$ oz. cyanide of copper dissolved in one quart of hot water and 2 oz. cyanide to every 10 gal. of solution. By changing the voltage from high to low, from light gray to coal black can be obtained. The work should be taken from the regular nickel tank and put into the black nickel without rinsing. A good black can be obtained in about 2 min.

Try Reducing Current

QUESTION No. 90.—I am having trouble with my nickel solution, the work coming out dark and hard to color. I have cleaned out the tank and added sulphuric acid, but very little change in the work. Will car-

bonate of nickel remedy it? How is it made?

ANSWER.—We judge you are using too high voltage. Try reducing your current. It is invariably cheaper to make a new nickel than to try to doctor up a poor one. Carbonate of nickel, or any other alkaline salt, added to a nickel solution, darkens the deposit.

Acid Silver Plating Solution

QUESTION No. 91.—Have been experimenting with acid silver plating solution and as yet have not been entirely successful. We would appreciate any information you can give us as to the proper formula for building up this solution, and just how the work should be handled to get the best results in plating parabolic reflectors for automobile head lamps.

ANSWER.—We would advise the use of the double cyanide of silver solution, using 5 oz. of cyanide of silver and 6 oz. cyanide of potash. With a current of not over two volts the solution will give better results than any acid solution.

Trouble Caused by Small Particles of Polishing Composition

QUESTION No. 92.—We are sending you under separate cover a clock gong. Kindly note the peculiar marks near "Alm. Set" and "Time." We thought perhaps you would like to see this. We wonder if you could tell us anything about it? We would appreciate any advice that you can give us in this connection.

ANSWER.—The streaks that start from the punch holes are caused by small particles of polishing composition left on the inside edge of the holes. If all the holes are thoroughly cleaned out before plating the streaks will not appear. Please note that the inside of the holes where the rays start are imperfectly plated, indicating the presence of the polishing composition.

Cleaning High Explosive Shells

QUESTION No. 93.—We desire to thoroughly clean high explosive forged steel shells after machining in order to get rid of all lard oil before varnishing the inside, and would ask if you know of any method by which we can do this work satisfactorily, other than the sand-blast process?

ANSWER.—In addition to the sand blast method described last month, another effective method is to wash them out with gasoline; if very greasy, they should be wiped out with sawdust, then finished with gasoline.

To Obtain Dead White Color

QUESTION No. 94.—Will you propose a method for obtaining a uniform dead white color from a silver solution? Wish to avoid the slightly yellow tinge.

ANSWER.—To obtain the dead white color, the articles after plating should be bleached in the following solution until dead white:

Hot water 1 gal.

Silver solution 1 pt.

Carbonate soda 4 oz.

Rinse in water made slightly acid with oil of vitriol and dry as usual.

To Copper Gray Iron

QUESTION No. 96.—We have a large number of gray iron faucets which we want to copper dip. The castings are cleaned free of sand by ordinary foundry pickle and afterward washed in potash. The dipping can be done either hot or cold.

ANSWER.—The dip used to copper gray iron is:

Water 1 gal.

Sulphate of copper 8 oz.

Oil of vitriol.....2 oz.

Saltpeter 1 oz.

After the iron is colored it should be rinsed in cold water and dipped in a strong soap wash, then dried as usual.

Wants a Cheap Dip

QUESTION No. 100.—Am working on steel articles for which I want a cheap dip which would darken them to almost a black; then they are japanned.

ANSWER.—The usual method of obtaining a dark surface for japanning or lacquering is to dip the steel in a 1 to 12 oil of vitriol pickle, then dry in a hot oven until the steel turns black.

Will It Spoil the Work?

QUESTION No. 101.—Using a cream tar-tar tinning solution, will lead washers around steam pipe fittings (inside as well as outside) have any effect on the work? Will the solution draw any of the lead off, and thus spoil the work?

ANSWER.—The lead washers will be eaten away by the solution, so should not be used. A small amount of lead will deaden the color of the deposit.

Rust on Typewriter Parts

QUESTION No. 102.—Please let me know a good way to keep small pieces of typewriter work from rusting. This work is put together and put in stock and oiled and it rusts anyhow.

ANSWER.—Melt together equal parts of rosin and petroleum, hard oil (vaseline) and mix, then allow to cool. Have parts thoroughly clean and dry; coat with mixture and you will have no trouble from rusting.

Making Solders and Babbitts

QUESTION No. 103.—What is the best way of melting lead and tin in making solders; also copper which is used in making babbitts?

ANSWER.—The regulation babbitt kettle affords the best way of melting lead and tin for making solders. These kettles are fired underneath, and the solder or babbitt is dipped out, usually with a ladle and is transferred to the molds which are of iron. In making copper-hardened babbitts the copper is melted in a regular brass furnace, and the antimony is added to the copper gradually and generally a little tin, the object of the latter being to make the antimony-copper alloy more fusible. The tin comprising the base of the alloy is melted separately in the babbitt kettle, and the tin added to the copper and antimony is deducted from the tin in the babbitt kettle. The molten tin, copper and antimony is poured from the crucible in which it was melted directly into the bath of molten tin in the babbitt kettle, the metal being thoroughly stirred meanwhile.

Might Try Cast Steel

QUESTION No. 104.—Please give formula for making a cheap iron fitting weighing about 2 oz. which will be tough and stand riveting. Ordinary cast iron will not answer the purpose. Malleable iron will do,

but it takes too long to turn out a finished product by the malleable iron foundries. Must have something that can be turned out quickly and cheaply.

ANSWER.—Absolutely nothing can be used for this purpose except cast iron, malleable iron and steel. Might try cast steel, or get the fittings stamped—outside field of BRASS WORLD.

Black Nickel Solution

QUESTION No. 105.—I am sending under separate cover sample of what is supposed to be black nickel plating solution. The plater that was on the job before I took it said it was, but I cannot get very good results with it. Will you let me know what it lacks or what is the trouble with it, if it needs anything? The work comes out too light, almost like white nickel.

ANSWER.—After testing the sample of solution, we beg to advise that it is useless to try to use it. For black nickel make solution as for ordinary nickel plating, then add rich cyanide copper solution until satisfactory black is obtained.

Soft Yellow Brass Castings

QUESTION No. 106.—We are sending you a sample of brass or bronze of which we purchased a quantity, and to this we have added about 15 per cent of zinc. All the castings have a pale color, are hard and brittle. Can you tell us its composition, also give us a mixture from which we can make good soft yellow brass castings.

ANSWER.—From an inspection of the chips we would say that the alloy sent is a copper-tin alloy containing a considerable percentage of lead. The addition of 15 per cent of zinc would render such an alloy hard and brittle. The chips should be used as they are, that is, without any further addition of either tin, lead or zinc. If a considerable quantity of these chips has been purchased, the most sensible thing to do would be to have an analysis made. The alloy then can be altered in any way desired, either by adding copper or white metals as required. A good yellow brass formula is as follows: Copper, 78 per cent; zinc, 27 per cent; lead, 3 per cent; and tin 2 per cent. The chips might be used in this alloy by omitting the tin from the mix, also 18 lb. of the copper, replacing the tin and copper by 22 lb. of chips.

Wants the Impossible

QUESTION No. 107.—Kindly send me a formula to make plaster of Paris water-proof without waxing, for metallizing purpose.

ANSWER.—Know of nothing that can be used for this purpose.

Washing Brass Without Strong Acids

QUESTION No. 108.—We have just purchased a brass paper fastener plant and the process for washing and brightening the brass has been a solution of sulphuric and nitric acids.

We are trying to find out if there is any way of washing and brightening the brass without using these strong acids, as we are so situated that it is necessary to put this washing room very close to a window, on account of the fumes; also, it requires a very expensive installation of piping to carry away the acid. This installation has to be made of earthenware and would have to be carried at least 1000 ft.

We thought possibly you could give us the name of somebody or some chemist who could furnish us with a solution that would answer the purpose just as well and would not require these strong acids.

We have a very large oven installed, which was put in by the gas company here.

ANSWER.—You might try washing the fasteners off in a wash made by dissolving 8 oz. of Castile soap in 5 gal. hot water, then adding $\frac{1}{2}$ pt. ammonia. After washing, rinse in cold water and dip for a few seconds in a dip made by dissolving 4 oz. of cyanide per gallon of cold water. After the cyanide dip, rinse in cold water and dip in the soap wash again. Rinse, dip in hot water and dry in sawdust. If it is necessary to use the acid dip, lead pipe should be used to carry away the acid water instead of earthenware pipe.

Trouble Silvering Mirrors

QUESTION No. 109.—We have been experimenting silvering mirrors and have found that a solution of silver nitrate and Rochelle salts gives us a very satisfactory silver deposit, but for our work the silvering has to be copper plated, and that appears to be where we are stuck, so I have been advised to write you. After the glass is silvered and is subjected to even the slightest current in a copper solution, the

silver film peels off in a sheet, even though the glass has been thoroughly cleaned.

ANSWER.—The only way you can cover the silver with copper is to sprinkle iron filings over the silvered surface, then spray or wash with a saturated solution of sulphate of copper. Deposits obtained as above should be protected with a heavy coat of lacquer.

Sound Castings

QUESTION No. 111.—We are making castings about 100 lb. and experience considerable difficulty in getting them sound. The metal is always more or less porous. The mixture used is copper, 90 per cent; zinc, 6 per cent; tin, 3 per cent, and lead 1 per cent. The castings are about 3/16 in. thick.

Where do you think the difficulty lies, in mixing the metal or in pouring the castings too hot?

ANSWER.—The cause of the difficulty lies in the method of melting, to remedy which, add a handful of rock salt when the copper is charged, and see that it is well-covered with charcoal as it melts. There are different opinions as to the cause of porosity, but in nine cases out of ten it will be due to lack of care in melting; and we believe that in this case, if the melting is carefully looked after, the difficulty will disappear. The addition of 6 oz. of phosphor copper per 100 lb. of metal melted is also recommended.

Acid Proof Mixture

QUESTION No. 112.—Let us know of a brass mixture that is acid proof.

ANSWER.—There is no alloy strictly acid proof, although some alloys withstand acids better than others. One of the most satisfactory alloys that can be used in this connection is made as follows:

Copper 90 per cent
Tin 10 per cent
Deoxidize with 5 oz. of 15 per cent phosphor copper per 100 lb. of metal.

Temporary Protection Against Tarnish

QUESTION No. 114.—Can you advise us of any liquid composition into which we can dip small brass parts that are wet, to prevent brass tarnishing, similar to water dip lacquer, but not containing the explosive elements of regular lacquers and thinners? We do not require it to do the service which the standard forms of lacquer do. We wish

merely to prevent tarnishing for the period of a few weeks.

ANSWER.—Dip in a wash made by dissolving 3 oz. of fish oil soap per gallon; then dip in hot water and dry in clean sawdust. The brass receives a film of oil that prevents tarnishing for quite a long time.

Black Finish Vanity Cases

QUESTION No. 115.—Will you explain how to procure a black finish on steel vanity cases by immersion?

ANSWER.—Steel vanity cases cannot be finished black by immersion. A cheap and satisfactory method is as follows: Copper plate the cases just enough to cover them all over, then dry and heat in a muffle furnace until the copper is converted into black oxide. If the cases are soft soldered it will be necessary to copper plate fairly heavy, then black with weak liver of sulphur solution.

Bontempi Process

QUESTION No. 116.—We are inclosing you herewith a piece of metal stamping and wish to ask if you can send us a formula for a dull black finish applied to this piece, and price for same?

ANSWER.—The sample submitted with your letter of the twenty-eighth has evidently been coated by a patented process known as the Bontempi rust-proofing process, or a similar one. This process was described in detail in the *BRASS WORLD* about three years ago, and also in the *U. S. Trade Review*, January, 1910. We have asked The Bontempi Rust-proofing Co. of Bridgeport, Conn., to submit samples of their work for your inspection, and believe they will quote you their terms.

Wormy on Top

QUESTION No. 117.—I would like to know what makes small castings appear "wormy" on top? I am using pipe and rod scrap in the metal.

ANSWER.—The wormy appearance is due to zinc oxide, and can be prevented by drawing off vents from the castings to the joints of the flasks, but more particularly by properly pouring the metal. Every effort should be made to keep the sprue head full of metal while pouring, and to attain this end the pot should be poised in front of the sprue and the mold filled with a sharp decisive movement. Slopping and dribbling

the metal must never be permitted in the pouring of yellow brass.

Black Nickel Plating

QUESTION No. 121.—We want a solution for black nickel-plating for use on material as per the two small samples we are inclosing. If you can help us out in this matter we would appreciate it very much.

ANSWER.—Following is the best nickel formula:

Double nickel sulphate.....8 oz.
Sulphocyanide of potash....2 oz.
Sulphate of zinc.....1 oz.
Water 1 gal.

Porcelain Will Answer

QUESTION No. 123.—What kind of tank should be used when heating manganese dioxide and saltpeter, as used in obtaining a blue on steel? I have tried out an iron receptacle, but the chemicals attack it and eat right through.

ANSWER.—Unable to answer, as do not know what the process is. However, porcelain will do if it is not too expensive. Iron vessels, porcelain lined, might answer.

A Gold Mine

QUESTION No. 98.—I have a process for depositing copper and various other metals on pure sheet aluminum by electroplating. Is there such a process now in use? If not, what is the commercial value of such a process?

ANSWER.—Although there is a great demand for a process by which aluminum could be plated, there is no practical method known. If your process is such that it can be used commercially, and the plate will not peel off, any large plating concern would find it a gold mine. Would suggest you send samples of your work to the large consumers of aluminum.

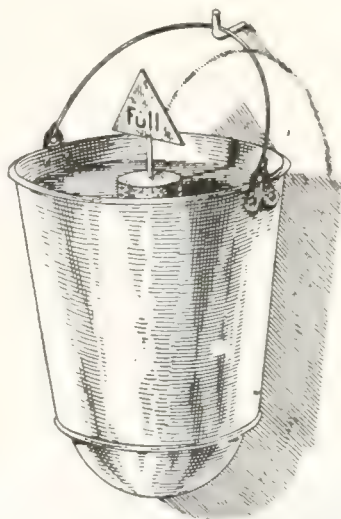
Brush Brass Finish On Iron

QUESTION No. 84.—We are trying for a brush brass finish on cast iron, and are having difficulty. Can you help us out?

ANSWER.—After the castings are cleaned for plating, dip in 1 to 6 muriatic acid; pickle until all the rust is removed, then plate in a strong hot copper solution until the castings are completely covered. Then brass plate as usual. The copper solution should contain 1 lb. of cyanide and $\frac{1}{2}$ lb. carbonate of copper per gallon, and should be used at from 180 deg. Fahr. to boiling.

Fire Bucket Float

A very convenient as well as necessary improvement to be applied to fire buckets is found illustrated in a recent issue of *American Machinery* and here reproduced.



The device consists of a cork or metallic float with a stiff wire spindle attached to it, on the top of which is fastened a triangular piece of sheet tin or aluminum, painted and lettered in colors that will contrast with the surroundings.

This saves the watchman from climbing on work-benches, up posts or the sides of the walls to see if the water buckets are full as required by the Insurance Associations.

When the bucket is full, the sign is visible for a considerable distance, but when the water has evaporated so that the bucket is only partly filled, the float disappears below the rim.

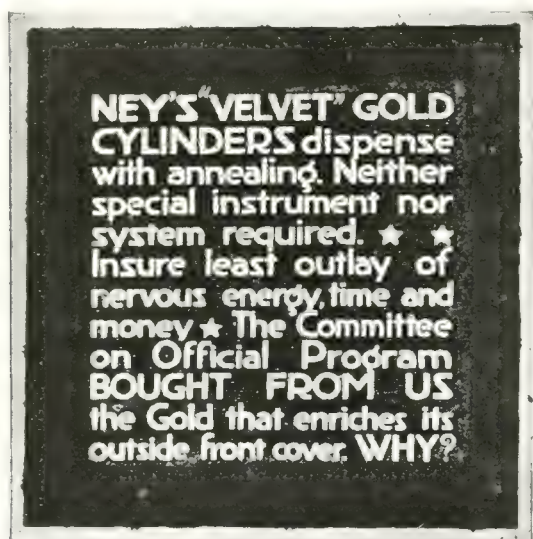
The Lockport Chemical Works, with main office and factory at Lockport, Ill. and Chicago store at 17 South Desplaines Street, report that their business is increasing in volume so rapidly that their present factory is inadequate. They have engaged an adjacent building which will give the additional space. They manufacture a line of metal cleaners, metal cyanide, copper and zinc cyanide mixture, high power nickel salts and special chemicals for platers and manufacturers. Their latest product is called Grit metal cleaner, which they claim is as cheap as dirt, but gets all of the dirt, and is equal to any electric cleaner at any price.

Their copper and zinc cyanide mixtures are for brass and copper solutions, and dissolve most freely because they are air dried,

take less cyanide, and save 25 per cent in the making and maintaining of solutions. Frederick C. Ohlmacher is manager of the company, a man very well known to the trade. He is an expert on electric cleaning of metals.

Wasteless Dental Goods

At the recent dental congress where there were all classes of suitable goods on view, a great deal of interest was shown in the gold preparations, alloys, etc., exhibited by The J. M. Ney Company of Hartford, who seem to be, notwithstanding their 104 years of business, just that many years young and vigorous. This was demonstrated, especially in the exhibit of wasteless dental goods. The goods were shown on panels,



fourteen in number, done in complementary tempora.

Instead of conventional wood frames, these panels had unique, wide, solid borders of Ney's gold foil. The gold effect was as attractive as the color schemes of the panels, of which no two were alike. The panels displayed reasons for the supremacy of Ney's "Best since 1812" products.

The entire series of panels are worthy of illustration, but one will serve to give the idea of the group, with the texts of some others which we quote.

"Ney ask those who have not used their World's best since 1812 dental golds, and solders, to investigate and compare.

"Over one-third of your outlays, doctor, goes for these articles. Are you getting full value for your money? If you're using Ney's you are.

"This is another: Ney's dental golds today, as always, the World's standard.

"By them all American and European brands are judged. Go farther. Really 'cheap' in price, but not in 'quality.'

"Another read, Ney's Gold Foil surrounds these panels. If you know its equal, will you favor us with the maker's address? In 103¾ years we've failed to find it.

"Some may leave us for a short time, on account of 'prices,' but never because of quality."

The J. M. Ney Company was represented by Pres. H. C. Ney, Dr. A. W. Woodman and J. R. Shamper. On a revolving table, and another that was stationary, were specimens of Ney's gold discs, gold nuggets, gold shells, gold plates (all karats), gold solders (all karats), Velvet gold cylinders, Velvet gold foil, Velvet gold ropes, gold wires (all karats), regular and high fusing clasp plate and wire, silver solders, plates and wires, platinum solders, plates and wires, granulated gold, silver and copper, for whose manufacture this concern enjoys an enviable reputation wherever dental supplies are sold and dentistry is practised. Among the articles was the latest product, Ney's Velvet mat gold, which excited considerable favorable comment from dentists and dealers. It is claimed for this article that there is nothing approaching it on the market. There were also displayed "Ney-Oro" casting golds, comprising a series of eight alloys, including three solders. By these, results hitherto impossible when casting golds, are readily obtained.

There was a fac-simile of "Welcome Stranger," the world's largest gold nugget found at Dunolly, Victoria, Australia, June 11, 1858. Original weighed 2195 Troy oz., value \$43,500.

The Eureka Sprayer

It is now fifteen years since the Eureka Pneumatic Spray Co. of New York City, turned out the first Air Brush, or Sprayer, for applying lacquer, paint, enamel, Japan, bronze, shellac, varnish, etc., for various degrees of finishing, supplementing the old method.

There is a labor saving of from 25 to 80 per cent, and a most durable finish produced by this process. The Eureka Pneumatic Spray Co. makes about thirty different sizes and models, so it is assured that some one of these will suit the particular needs of a customer. There is no reason for even

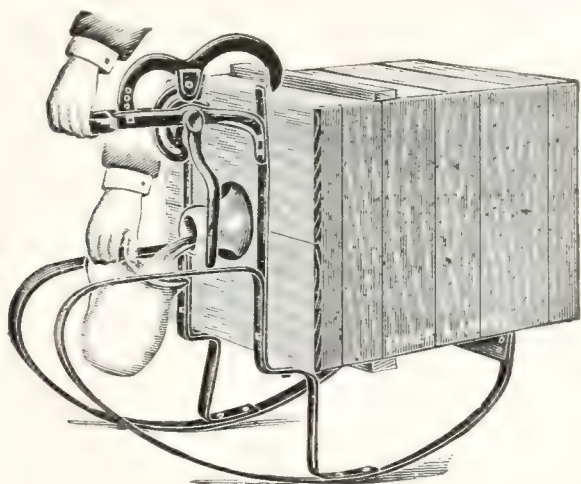
the small user of lacquers, or for any plating room, to be without an outfit, as the company is offering at \$33 a complete outfit of the highest grade.

The superiority of the Eureka sprayers is being demonstrated daily. Catalog, including description and prices, will be mailed, explaining any type of sprayer, from an Art Brush to one of gallon capacity.

A Device for Handling Acid in Carboys

The accompanying cut shows the Flaherty Carboy Inclinor, a device for handling acids in carboys.

By means of this apparatus the carboy may be tilted and its contents poured out of



same with the least exertion and with absolute safety from spilling or splashing.

A single movement of the lever locks the Inclinator to the carboy like a skate to a shoe. A pull on the handle then tilts the carboy and allows the contents to be poured out. By an ingenious curvature of the rockers the carboy resumes its upright position as soon as the pressure is released.

Any number of carboys can be handled with this device, as it is clamped on or taken off in a few moments. The Inclinator is fitted to the carboy now in standard use but can be made to fit also the new standard carboy.

It is being placed on the market by Eimer & Amend, 205 Third Avenue, New York City.

According to statistics compiled by J. M. Hill for the *Geological Survey*, the production of refined platinum in the United States in 1914 was 3541 oz., or more than three times that reported in 1913, when it was 1034 oz.

List of Exhibitors

(Continued from page 362)

- Tabor Mfg. Co., Philadelphia. Molding machinery in operation.
- Thomas Iron Co., Easton, Pa. Thomas-Vanadium pig iron.
- Titanium Alloy Mfg. Co., Niagara Falls. Samples of titanium-treated iron, brass, bronze, etc., castings.
- Union Steam Pump Co., Battle Creek, Mich. Horizontal compressors.
- U. S. Graphite Co., Saginaw, Mich. Graphite products for foundry use.
- Waterbury Welding Co., Waterbury, Conn. Foundry riddles.
- Westinghouse Electric & Mfg. Co., Pittsburgh. Arc welding sets.
- White & Bro., Philadelphia. Ingot metals and castings.
- Whiting Foundry Equipment Co., Harvey, Ill. Foundry equipment by means of pictures.
- Willson, T. A., & Co., Inc., Reading, Pa. Safety glasses and eye protectors.
- Wood, T. B., Sons Co., Chambersburg, Pa. Wood system of molding.
- Woodison, E. J., Co., Detroit. Automobile cylinders made by liquid core binder.
- Wyoming Shovel Works, Wyoming, Pa. Shovels.

More Compliments

Mr. J. B. Neiman of the Great Western Smelting & Refining Company writes: "Your August issue was received by the writer the other day, and he wishes to compliment you on the wealth of interesting subjects, as well as the thoroughness of preparation of articles, especially those pertaining to non-ferrous metals."

Wholly unprecedented demands for ammunition have been made in the present war by field artillery, in the use of which both Germany and France have made amazing strides. The fighting forces in comparatively unimportant engagements have employed quantities of shrapnel and explosive shells that before the beginning of the present war were commonly regarded as sufficient to supply large armies for many weeks. The entire reserve stocks of the United States for offensive and defensive operations would hardly serve to keep the French and German batteries going a week.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES

Bridgeport—Meets on the third Friday of each month at 260 John Street, Bridgeport, Conn. Secretary Nelson Barnard, 858 Howard Avenue, Bridgeport, Conn.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, S. Wroblewski, 1486 Elmwood Avenue, Buffalo, N. Y.

Chicago—Meets fourth Saturday of each month at 8 P. M. at Western Building, Randolph and Michigan Avenue. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Avenue, Cincinnati, Ohio.

Cleveland—Meets last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Avenue, Cleveland, O.

Dayton—Meets first Wednesday of each month at Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 First Street. Secretary, E. E. Miller, 543 Townsend Avenue, Detroit, Mich.

Indianapolis—Meets last Saturday of each month at the Denison Hotel. Secretary, Arthur Nelson, 1617 Shelby Street, Indianapolis, Ind.

Milwaukee—Meets second Wednesday of each month at Marquette University. Secretary, E. C. Yaeger, 962 Ninth Street, Milwaukee, Wis.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 West Madison Avenue, Irvington, N. J.

New York—Meets fourth Friday of each month at 258-262 Pearl Street, New York City, at 8 P. M. Secretary, Wm. Fischer, 345 East 23d Street, New York.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Rochester—Meets second and fourth Friday of each month at University of Rochester. Secretary, C. V. Haring, 603 Dewey Avenue, Rochester, N. Y.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, F. Rushton, 4405 Blair Street, St. Louis, Mo.

Toledo—Meets every Wednesday at Toledo University. Secretary, James E. Nagle, 209 Navarre Avenue, Toledo, Ohio.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Society Notes

THE AUTUMN MEETING OF THE INSTITUTE OF METALS.—The following is a list of the papers that are expected to be submitted at the meeting of the Institute of Metals, to be held at the Chemical Society, Burlington House, Piccadilly, W., Sept. 17:

"The Corrosion of Gun-Metal." By Dr. C. H. Desch.

"Metallic Crystal Twinning by Direct Mechanical Strain." By Prof. C. A. Edwards, D.Sc.

"The Constitution of Brasses Containing Small Percentages of Tin—A Contribution to the Study of the Ternary System, Copper-Zinc-Tin." By Dr. O. F. Hudson and Mr. R. H. Jones, D.Sc.

(a) "Structural Changes in Industrial Brasses"; (b) "Hardness of Copper-Zinc Alloys." By Dr. D. Meneghini.

"Specifications for Alloys for High-Speed Superheat Steam Turbine Blading." By Mr. W. B. Parker.

"The Physical Properties of Metals as Functions of Each Other." By Mr. A. H. Stuart, D.Sc.

"Detection of Internal Blow-Holes in Metal Castings by Means of X-Rays." By Mr. C. H. Tonamy.

The regular meeting of the Toronto Branch was held on Thursday, Aug. 26, with President Salmon presiding over a good attendance. After the regular routine business had been disposed of a general discussion on plating subjects and tin plating in particular, was enjoyed by all.

New Publications

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS, Vol. XXVII. Published quarterly by the Society, Washington, D. C.

The August number of the society's journal is a very interesting issue and will prove of value to others besides the naval engineers in whose interest it is published.

REPRINT OF PAPERS TO BE DELIVERED AT THE ATLANTIC CITY CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

By courtesy of the secretary of the association we are enabled to read the papers in advance of delivery by the writers. They will not be released for publication until after the meeting of the society.

TRADE NOTES

The Electric Meter & Stamping Metal Company's plant at New Hamburg, Ont., was destroyed by fire with a loss of over \$30,000. The company manufactures stamps, dies, etc. John Messner is manager.

The Ross Supply Company, Greenville, Ohio, expects to make an addition to its foundry at an early date.

The Titan Metal Company, Bellefonte, Pa., with a capital stock of \$100,000, has been incorporated by F. E. Naginey and others to manufacture metals and metal products.

The Hamilton-Beach Company, Racine, Wis., manufacturing various electric appliances, including vibrators, beverage mixers, telephonic apparatus, etc., is awarding contracts for the erection of a brick and steel factory building on High Street and the Chicago & Northwestern tracks. The company is now occupying part of the buildings of the F. J. Greene Engineering Works, but recently was obliged to lease additional factory space from the Racine Stool Company. The Greene Works are also crowded for room.

The New Departure Mfg. Company, Bristol, Conn., has let a contract for the erection of a one-story building, 127 x 252 ft., to house its grinding department. It is reported that the company is planning three additions to other departments.

During the past two years the Ele-Kem Co., 1510 Clybourn Avenue, Chicago, has produced numerous samples of lead-plated articles which have successfully withstood salt water and fume conditions. On account of the large demand for material of this kind, this firm has recently equipped its plant for handling large quantities of this work under contract for manufacturers.

Work will start Aug. 23 on several additions to the plant of the Bridgeport Brass Company on Housatonic Avenue, Bridgeport, Conn.

The Sanitary Mfg. Company, Kenova, W. Va., has been incorporated with a capital stock of \$300,000. It has acquired pos-

session of part of the plant of the Independent Steel Company at Kenova, and will install a brass foundry and machine shop. It will be in the market for equipment for the new plant. The president is O. M. Bake.

Manning, Bowman & Co., Inc., makers of enameled ware, Meriden, Conn., have increased their capital stock from \$100,000 to \$600,000 to take care of their increased business. They have awarded contract for a building 43 x 200 ft., containing about 9000 sq. ft. of floor space.

The United Smelting & Aluminum Company, New Haven, Conn., is enlarging its plant, adding a new three-story building, materially enlarging floor space and storage warehouses. The company is installing the most modern improvements for the production of pure aluminum ingots, alloys, shot or granulated aluminum, aluminum solder, etc., including ten new melting furnaces, which will give a capacity of over 20,000 lb. per day. The company invites correspondence with all concerns interested in the mentioned products, being in better position than ever to take care of all aluminum wants.

The Federal Zinc & Lead Company, Huntington, W. Va., has been incorporated with a capital stock of \$200,000 by Frank Enslow, Jr., Frank Ellington and G. D. Miller.

A four-story addition to the plant of the J. Wiss & Sons Co., Newark, N. J., will be erected at a cost of \$15,000. The new addition will be 50 x 75 ft. and will be constructed of brick to conform to the rest of the factory. The Wiss company manufactures cutlery.

The Cleveland Blow Pipe & Mfg. Co. has secured a contract to emplace its dust-collecting system to provide for 24 buffing and polishing wheels in the plant of the Enterprise Aluminum Co. The company is also working on contracts for equipping a system for 13 wheels for M. C. Lilley & Co., and a large system to take care of 34 wood-working machines at the Mutschler Bros. Co.

Mr. R. H. Evans, so long identified with the Frictionless Metal Company as general manager, has resigned to accept the general managership of the Michigan Smelting & Refining Company at Detroit. The strength of the new company and the wide range of its influence will give Mr. Evans a large opportunity.

The Buckeye Aluminum Company, Wooster, Ohio, is making an addition to its power plant.

Royal F. Clark, formerly with the Eagle Glass & Mfg. Co. of Wellsburg, W. Va., as foreman of plating department, is now with the Acme Shear Co. of Bridgeport, Conn., in a similar position. Mr. Clark was invited to address the Bridgeport branch, A. E. S., recently.

The Gary (Ind.) Mills of Am. Sheet & Tin Plate Co., which are the world's largest, have resumed work at full capacity.

The manager of the N. & G. Taylor tin mills in South Cumberland, Md., denies all war orders; only domestic trade for him.

Charles G. Davis, assistant treasurer of Central Stamping Co., died at his Madison, N. J., home July 15, aged 55.

Gerlach-Coffield Tinning & Furnace Co., Indianapolis, was incorporated for \$25,000. A. W. Gerlach, J. V. Coffield and W. F. Bailey.

The recently organized Cleveland (Ohio) White Metal Co. is putting up new type of buildings. It has the appearance of a mammoth unprofessional greenhouse.

A representative of the Department of Commerce is touring New England instructing the metal trades how to go about it to get South American business.

Eighty-five per cent of the brass and copper made up is done in Connecticut, and Maryland has the largest copper refining industry in the world.

Stamford Rolling Mills Company of Springdale, Conn., recently purchased the plant formerly operated by the United German Silver Co. and is making improvements to the extent of about \$50,000, increasing the mill in all its departments. The company has a capital stock of \$255,000; preferred, \$85,000; common, \$170,000. E. R. Dick of Dick Bros., bankers, is president; F. W. Blake, general manager; R. A. Wood, superintendent; A. P. Meng, chemist. The company proposes to make quality products exclusively. It has opened a sales office at 25 Broad Street, New York, rooms 1206, 1207 and 1208, and solicits inquiries where quality is essential.

The Michigan Crown Fender Company, manufacturer of automobile fenders and metal stampings, is to locate at Ypsilanti,

Mich., and will occupy a building 80 x 400 ft., to be erected for it.

The National Tube Company, Kewanee, Ill., is about to add to its foundry department, and in this connection will install sanitary equipment estimated to cost \$25,000. A new forge shop to manufacture parts of steel unions is in progress.

The Bristol Brass Company, Bristol, Conn., will erect opposite its present plant on Broad Street a new factory, 125 x 300 ft. When the new building is equipped the working force will be doubled.

The Novelty Stamping Company, Bellaire, Ohio, will make some additions to its plant. Details are not yet available.

The McCord Mfg. Company, Detroit, manufacturer of automobile truck accessories, has purchased the large plant of the Tilden Saw Company, Wyandotte, Mich., and will increase its facilities.

The Milwaukee Die Casting Company, occupying the basement of the Manufacturers' Home Building, foot of Mason Street, Milwaukee, will move about Nov. 15 to its own home, now under construction on Fourth Street. The foundry will be 50 x 60 ft., of brick and mill construction. The company manufactures die castings in aluminum, babbitt, bronze, brass and copper.

The proposed foundry addition to the plant of the Nolte Brass Company, Springfield, Ohio, will be 45 x 210 ft., one story, of brick and steel construction.

The La France Fire Engine Company, Elmira, N. Y., has let contract for a two-story and basement addition to its plant, 130 x 150 ft.

Spencer (Mass.) Wire Co. is reported as considering sites for erection of new plant. J. Theobald is superintendent, and should be addressed.

W. J. Johnson, general manager of the Kokomo (Ind.) Brass Works, announces that two additions will be made to the factory, doubling the capacity. Both new buildings will have three stories. The company is employing 610 men, working day and night shifts. Mr. Johnson said that when the buildings were completed the company would employ 1000 men, still working two shifts. The company manufactures automobile parts.

The National Enameling & Stamping Company's plant at Granite City, Mo., will be reopened to handle several big orders.

The Cleveland (Ohio) Metal Products Co. will erect a two-story brick and steel building.

The Detroit (Mich.) Metal Refining Co. has installed forty-eight new furnaces for refining aluminum, brass, dross and pig lead.

Great activity prevails in the zinc mines at Embreeville, Tenn. More than 600 men are at work in the mines. Five or six large buildings for the zinc plant have been completed, and a large zinc mill will be installed at an early date.

James H. Rhodes & Co., of 162 West Kinzie Street, Chicago, have purchased a five-story office building at 157 West Austin Avenue, Chicago, and they expect to take possession of same about May 1, after certain improvements have been made in the building. The business of this firm has been steadily increasing, so that it became necessary, in addition to the warehouses and pumice mill which they have in Chicago, to secure larger office quarters.

William Coskey, Philadelphia, Pa., is erecting a brass foundry for his use at Richmond and York Streets. The structure is to be 50 x 90 ft.

The Solar Metal Products Co., Columbus, Ohio, has a new building in which machinery is being installed.

German Silver Mfg. Co., Springdale, Conn., is putting up an addition 45 x 90 ft.

At the Waclark Wire Works, Elizabeth, N. J., a brass foundry is being erected and is now nearing completion. It is built of brick and will be one story in height and entirely fireproof. This structure will cost \$16,000.

The Norwich (Conn.) Nickel & Brass Co. has sold its former premises, and will move into the former plant of C. B. Rogers.

The machine shop and press department of the Novelty Stamping Works, Wheeling, W. Va., is being moved to Massillon, where it will be installed in a new plant erected at that place. The space in the local plant will be equipped with furnaces and dipping rooms, and, it is said, will require a larger number of employees. The work of converting the machine shop into an enameling works will be started soon.

Topeka (Kan.) Ornamental Iron & Metal Works is to put up a new two-story brick plant, 25 x 100 ft.

Trade Opportunities

The names and addresses of subscribers who have sent in any of the following inquiries will be furnished to any of our advertisers on application.

Inquiry No. 25—Burnishing Machines

We are somewhat interested in procuring machines for burnishing solid steel handle knives and forks. Can you give us any information as to who makes such machines and the most practical ones on the market?

Inquiry No. 26—Enamel Plant—Dipping or Spraying Devices

We are also putting in an enameling plant for enameling black iron. For this enameling plant we should like to have you give us the names of some people who could furnish us with the right kind of pans and paints, and who also could install a dipping or spraying device for doing this work.

Inquiry No. 27—Metallic Arsenic

Can you kindly advise me where metallic arsenic is obtainable in small and large lots in this country?

Inquiry No. 28—Machine for Trimming Car Journal Bearings

We are manufacturing quite a number of car journal bearings, and we feel that our methods of trimming the lead lining material from these bearings is somewhat crude, and we believe that some one makes a special machine for doing this work.

You no doubt understand that after the bearings are made they are bored out in the journal, then tinned, and babbitted with a lining material usually composed of 87 per cent lead and 13 per cent antimony. After the babbitt is poured in it leaves a rough condition, always on one end and frequently on both ends; these ends have to be trimmed neatly, and if there is a machine made for doing this kind of work we are anxious to secure same.

Any information you can give us relative to this matter will be very much appreciated.

Inquiry No. 30—Small Brass Foundry

Would you be good enough to give us layout and estimate for a small Brass Foundry with furnaces to take up to a seventy-five-pound Crucible? If this is not in your line would you be good enough to refer us to the proper source in order to receive such information?

RECENT PATENTS

Electroplating Process

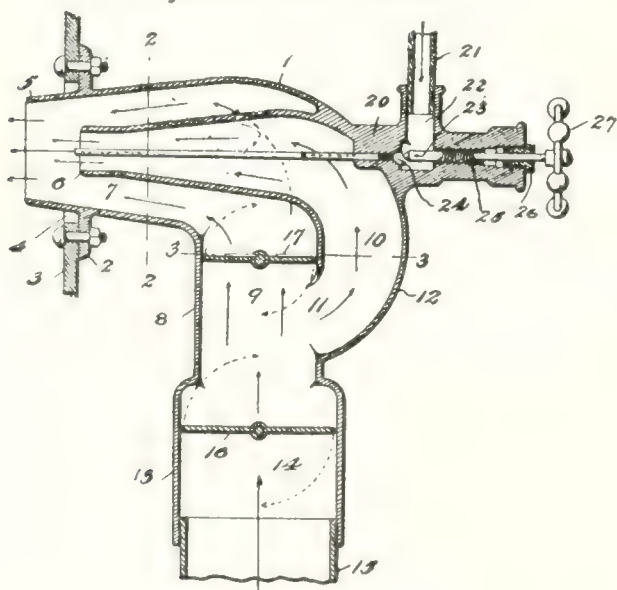
A process for electroplating non-metallic substances which consists in first applying a moisture and acid proof filling and coating, then applying a sizing coating, then applying an adhesive ground coating, then applying a powdered conducting material, and finally electroplating the surface thus prepared.

The claims also specify an adhesive ground coating composed of a mixture of litharge, asphaltum, methylated spirits and a gum resin. The proceeding as above.

Another process claimed consists in first applying a moisture and acid proof filling and coating solution of asphaltum, methylated spirits, stearic acid and glycerin, then applying a sizing coating, then applying an adhesive ground coating, then applying to said ground coating a first coating of a dry powdered conducting substance, then applying a second coating of the conducting substance mixed with a volatile liquid, and finally electroplating the surface thus prepared.

(U. S. Patent 1,144,226, March 16, 1915. Serial No. 14,800. Charles B. Mills, Baltimore, Md.)

Hydrocarbon Burner



This shows an integral casing formed with an inlet pipe having a valve therein, an outlet nozzle, and an outwardly curved back wall between these members, a blast nozzle in the outlet nozzle with walls projecting from the wall at the rear of the outlet nozzle, and both nozzles having inlet openings in direct communication with the

inlet pipe, a valve regulating the inlet opening to the outlet nozzle, and an oil feed pipe extended through the blast nozzle.

(U. S. Patent 1,144,851. Aug. 8, 1911. Serial No. 642,977. Robert G. Kirkwood, Pittsburgh, Pa.)

Skimming Ladle



A ladle comprising a bowl having a spout and handle, said bowl having an annular inturned lip at its rim extending transversely above the lip of the spout completely around the bowl to prevent accidental spilling of the metal and to permit the pouring of pure metal free of impurities and oxidized portions on the surface.

(U. S. Patent 1,145,422. Nov. 19, 1912. Serial No. 732,394. J. L. Jones, Wilkesburg, Pa. Assignor to George L. Curtiss Co.)

Treatment of Surfaces of Aluminum or Alloys of Aluminum in Order to Prepare Them for Receiving a Metallic Deposit

A process of treating surfaces of aluminum or its alloys to prepare them for receiving a metallic deposit, which consists in subjecting the previously cleansed surfaces to the action of a weak bath containing a hydracid holding a soluble metal in solution, thereby to precipitate a deposit of said soluble metal upon said surfaces and to liberate hydrogen which remains occluded in the deposit where it adheres to said surfaces, rinsing said surfaces, and passing the surfaces through a hot bath constituted by a saturated solution of a salt capable of expelling the occluded hydrogen and of fixing on said surfaces the soluble metal employed.

(U. S. Patent 1,144,000. Jan. 19, 1914. Serial No. 813,062. F. A. Roux, Paris, France, assignor to Société L'Aluminium Francais.)

Metal Coating Process

A process of the nature disclosed for lead-coating iron surfaces, consisting in initially obtaining a clean iron surface, and then contacting the same with a fused lead-bearing bath in the presence of metallic cadmium.

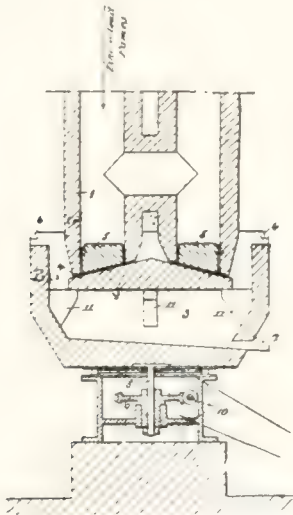
The bath is varied in the claims containing a relatively small proportion of cadmium, or again, a large per cent of lead and smaller of zinc and cadmium, with which a flux is used.

(U. S. Patent 1,144,523. Aug. 18, 1911. Serial No. 644,888. Jay C. Beneker, Cincinnati, Ohio.)

Alloy Coating Process

This is analagous to the Metal Coating Process, save that only a bath of fused lead containing considerable antimony and a small amount of cadmium, and contacting an iron surface therewith in the presence of a suitable flux is used. Patent 1,144,524.

Condenser for Zinc and Lead Vapors



In an apparatus for condensing vapors there is a condenser attached having a loose bottom and means to rotate it, with chamber below condenser for collecting the condensed matters. The chamber has means for sealing it against the atmosphere.

(U. S. Patent 1,145,685. April 21, 1915. Serial No. 22,788. E. A. Johansson, Trolhättan, Sweden.)

Electric Welding and Fusion-Deposition of Metals

An electrode for use in a process of electric welding or fusion-deposition of metals, comprising a metallic core and another metal adjacent to core, and being capable of exerting a strong reducing action at the fusion temperature, and an insulating layer upon the core.

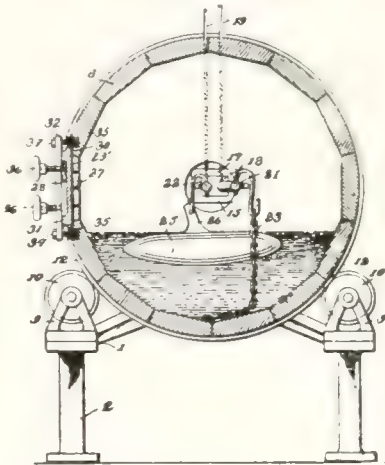
The wire of another metal (aluminum) having a greater affinity for oxygen than the core metal, and laid alongside the metal

core, and an insulating coating around the core and wire is a second claim.

The fourth claim is on the ground of a new article, and the following claim is to the effect that according to the nature of the metal to be deposited, a relatively fine wire of aluminum disposed adjacent to core along the same, and a binding of a material of a refractory fibrous nature such that it will melt and form a slag at the fusion temperature of the core.

(U. S. Patent 1,144,390. Dec. 23, 1914. Serial No. 878,808. A. P. Strohonenger, London, England, assignee to Slaughter & Co., also of Great Britain.

Plating Barrel



The claims call for an electroplating device, the combination with a rotatable tank arranged on a horizontal axis, conducting rods, said tank having an opening in one end thereof, and means for supporting conducting rods whereby the same may extend through said opening into tank, supporting means for the rods including an insulating block, anodes supported by one of rods and cathodes suspended from other rod.

A standard projects up from framework supporting barrel near one end, having a recessed block; a similar block secured thereto, and an insulation block clamped in recess between first named blocks and electrode-supporting rods, carried by insulation block, and extending into barrel.

An anode having a supporting arm or shank projects from the upper surface at an inclination, the part of the anode on one side of the shank being of greater vertical thickness than the part on the other side.

(U. S. Patent 1,135,660. Aug. 10, 1911. Serial No. 643,347. F. S. Chase and J. H. Graham, Torrington, Conn. Assignors to the Standard Co.)

CLASSIFIED ADVERTISEMENTS

Advertisements for Situations Wanted published free of charge for subscribers. Help Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars.

Help Wanted

WANTED—Good capable man to take charge of plating, polishing, buffing and lacquering department in large electrical concern in Middle West. Give references and state experience. Address Box 13, BRASS WORLD, Edison Bldg., New York.

WANTED—Chemist, experienced in conducting chemical and physical tests of steel. Man with experience in electrolytic chemistry preferred. State references and salary expected. Address Box 10, BRASS WORLD, Edison Bldg., New York.

SALESMAN wanted by concern making a superior line of supplies for metal finishers. Must be acquainted with the trade. Commission basis only. Liberal inducements to the right man. Address Box 3, BRASS WORLD, Edison Bldg., New York.

SALESMAN—Concern in the West making plating and tumbling machinery and selling plating supplies, wants first-class salesman for the Eastern territory. Must be a practical plater and able to demonstrate the apparatus. Address Box 501 BRASS WORLD, Edison Building, New York.

SALESMAN—I want a salesman who is well acquainted with brass sheet and tube buyers throughout United States; also thoroughly conversant with trade requirements. Address in confidence, with all particulars, "C. M. G.," 524 South Spring Street, Room 625, Los Angeles, Cal.

PLATER—To take charge of plating room. Must be familiar with work in copper, brass, nickel, etc., but experience in gold, silver, etc., not necessary. Address Box 17, Brass World, Edison Bldg., New York.

Situations Wanted

PLATER—First-class; steady. Can mix and run all solutions, barrel and still plating. Ball burnishing, etc. Desires to change. Moderate salary. Address Box 11, BRASS WORLD, Edison Bldg., New York.

PLATER—I understand plating, polishing, buffing, lacquering and oxidizing of all metals. Can also nickel plate sheet zinc and castings. Address Box 926, BRASS WORLD, Edison Building, New York.

PRACTICAL MAN—Understanding plating, polishing, buffing. Over 20 years' experience. Wants place as superintendent or foreman of departments named in a manufacturing plant. Best references. At present engaged, but desire to change. Address Box 12, BRASS WORLD, Edison Bldg., New York.

EXPERT PLATER—Nickel, copper, brass and zinc plating. Seventeen years' experience. Assure best work, and at a great saving. Address Box 1, BRASS WORLD, Edison Bldg., New York.

FOREMAN ELECTRO PLATER—Well known in the trade, is desirous of connecting with a reliable concern. Have had a broad experience on a large variety of work, in gold, silver, nickel, black nickel, copper, brass, bronze and zinc plating, on silverware, bicycles, stoves, saddlery hardware, typewriters, builders' hardware and all kinds of brass goods. Thoroughly understand all solutions and the production of all finishes, both standard and special. Capable of handling large departments, including polishing, buffing, burnishing, lacquering and etching. Sand tumbling, barrel polishing and ball burnishing. Barrel plating of all kinds. Modern methods for economical production. Address Box 2, care BRASS WORLD, Edison Bldg., New York.

PLATER, POLISHER and BUFFER—Wide experience, desires position where executive ability is required. Have made and used all known solutions on any line of work. Installing plants, and introducing efficient systems for day or piece work a specialty. Address "Experience," care Brass World, Edison Bldg., New York.

POLISHING—This one thing I know. Have made many labor-saving devices, reducing cost over one-half, at same time doing better work. Are used in present position. Twenty years spent in studying and producing results. High references. Address "POLISHER," care Brass World, Edison Bldg., New York.

FOREMAN PLATER—Experienced man can take charge of polishing and buffing; has good reference from last place, where I had charge of the plating department in fancy brass goods. Experienced on such goods as chafing dishes, percolators and electro tin, also silver plating. Address Box 4, care Brass World, Edison Bldg., New York.

UP-TO-DATE PLATER—Want employment with manufacturer who desires practical man, thoroughly understanding the reactions of solutions of all metals, and who can produce work satisfactorily and economically. Will take hardest proposition and work it out if it can be done. Want only a reasonable salary, but want to get located. Address Box 924, BRASS WORLD, Edison Bldg., New York.

FOREMAN PLATER—Have twenty-two years' experience; can take charge of polishing and buffing departments; have good references; thoroughly up-to-date on all solutions and finishes; mechanical plating and polishing barrels; can handle help to advantage and show results. Address Box 921, BRASS WORLD, Edison Building, New York.

PLATER—Married; fourteen years' experience at all finishes, gold, silver, nickel, copper, brass, bronze, oxidizing, etc.; make all solutions. Have had wide experience on

various articles of manufacture. Steady and sober; quick worker. Will leave city, if permanent position. Address Box 922, BRASS WORLD, Edison Building, New York.

PRACTICAL PLATER—Foreman plater with electrochemical knowledge desires to connect with a reliable firm where his knowledge would be useful. At present employed as foreman of a plating, polishing and finishing department. Want to make change. Address Box 918, BRASS WORLD, Edison Building, New York.

BRASS FOUNDRY FOREMAN—Wanted position as foreman or assistant in brass or aluminum foundry. Familiar with metal mixing machines and all up-to-date methods of molding. Wide experience; good references. Address Box 15, Brass World, Edison Bldg., New York.

For Sale

FOR SALE.—Plating dynamo, Form N, No. 3, Hanson & Van Winkle, complete with rheostat. In first-class condition. Used but a short time. Write Buffalo Scale Co., Inc., Niagara and Ferry Streets, Buffalo, N. Y.

SMALL electroplating outfit used two months. Address Box 9, care of BRASS WORLD, Edison Bldg., New York.

FOR SALE.—A first-class brass foundry in a rapidly growing city in western New York. Made over \$10,000 last year on small capital. Reason for selling—age and ill health. Address Box 920, BRASS WORLD, Edison Building, New York.

Wanted—Tilting Furnace

WANTED—Tilting furnace, No. 275 crucible, Monarch style. Coke fuel. Address Box 923, BRASS WORLD, Edison Bldg., New York.

Bone and Ivory Chips Wanted

WANTED—Bone and ivory chips or dust, waste of manufactured articles of bone and ivory. Send prices and samples, also quantities produced. Will pay cash for the right materials. Address Box 14, BRASS WORLD, Edison Bldg., New York.

Current Metal and Supply Prices

It is impossible in giving a list of current prices of metals and chemicals to do more than to furnish quotations which are approximately correct at the time of going to press. The prices of many of the items included below are influenced by war and other conditions which make them unstable at the present time.

CHEMICALS

Acetone, pure 98-99 per cent.....	Nominal	Lead, red (pure).....	.15 lb.
Acid, acetic, pure 30 per cent.....	.10 lb.	Lead, yellow oxide (litharge)	.15 lb.
Acid, arsenious (white arsenic).....	.10 lb.	Liver of sulphur, see Potassium sulphide.	
Acid, boracic (boric), pure.....	.15 lb.	Manganese, metallic, pure and carbon free,	
Acid, hydrochloric, see Acid, muriatic.		Magnesium, metallic	
Acid, hydrofluoric, 30 per cent... .03 @	.03½ lb.	Mercury bichloride (corrosive sublimate),	
Acid, hydrofluoric, 48 per cent... .06 @	.06½ lb.	crystals	
Acid, muriatic, 20 deg.....	.05 lb.	Nickel and ammonium sulphate (double	
Acid, muriatic, c. p., 20 deg.....	.12 lb.	salts)	.08 lb.
Acid, nitric, 38 deg.....	.05¾ lb.	Nickel carbonate, dry.....	.60 lb.
Acid, nitric, 40 deg.....	.06 lb.	Nickel, metallic	.60 lb.
Acid, nitric, 42 deg.....	.06½ lb.	Nickel sulphate (single salts).....	.18 lb.
Acid, nitric, c. p.....	.14 lb.	Nitre (saltpetre), see Potassium nitrate.	
Acid, sulphuric, 66 deg.....	.05 lb.	Oil of vitriol, see Acid, sulphuric.	
Acid, sulphuric, c. p.....	.12 lb.	Paraffin, high viscosity.....	.19 @ .26 lb.
Alcohol, wood	.55 gal.	Phosphorus	.35 @ 1.00 lb.
Alcohol, denatured	.55 gal.	Pitch	.05 lb.
Alum, burnt and powdered technical.....	.15 lb.	Plaster of Paris, dental	.05 lb.
Alum, commercial	.07 lb.	Potassium bichromate, c. p.....	.50 lb.
Ammonium sulphate	3.37½ @ 3.40 lb.	Potassium carbonate	
Aqua-Fortis, see Acid, nitric.		Potassium cyanide chloride mixture.....	.23 lb.
Ammonia water (aqua-ammonia), 20 deg.,		Potassium iodide	
Ammonia water (aqua-ammonia), 26 deg. .07 lb.		Potassium nitrate (nitre or saltpetre).....	
Ammonia water, c. p.....	.10 lb.	Potassium permanganate	1.25 @ 1.50
Ammonium carbonate, lump.....	.15 lb.	Potassium, red prussiate.....	2.50 @ 2.75
Ammonium chloride (sal-ammoniac) ..	.09½ lb.	Potassium sulphate (liver of sulphur)...	.20 lb.
Ammonium hydrosulphuret	.25 lb.	Potassium sulphuret, see Potassium sulphide.	
Ammonium sulphate	.07 lb.	Potassium sulphocyanide	Nominal
Amyl acetate	3.25 gal.	Pumice, ground	.05 lb.
Antimony (fine powder).....	.25 @ .26 lb.	Rosin, yellow	.08 lb.
Arsenic, metallic	.10 lb.	Sal-ammoniac, see Ammonium chloride.	
Arsenic, white (acid arsenious)	.10 lb.	Sal-soda, see Sodium carbonate.	
Benzol, pure		Silver chloride, dry.....	.65 oz.
Bismuth, metallic		Silver cyanide	.50 oz.
Blue-vitriol	.12 lb.	Silver nitrate, crystals	.45 oz.
Borax, crystals or powdered	.12 lb.	Silver trisalyt	.24 oz.
Borax, powd., refined, bbl.....	.05¾ lb.	Soda-ash	.05 lb.
Borax, lump, refined, bbl.....	.05¾ lb.	Sodium baborate, see Borax.	
Borax glass	.30 lb.	Sodium bisulphite	.05 lb.
Carbon bisulphide	.20 lb.	Sodium carbonate (sal-soda), crystals... .02 lb.	
Calcium carbonate (precipitated chalk) ..	.10 lb.	Sodium hyposulphite ("hypo").....	.04 lb.
Chrome-green, c. p.....	.26 @ .30 lb.	Sodium, metallic	
Cobalt, metallic, pure and carbon free..	2.50 lb.	Sodium nitrate	.05 lb.
Cobalt, black peroxide.....	1.50 lb.	Sodium phosphate (crystal).....	.09 lb.
Copper acetate (verdigris).....		Sodium silicate (water-glass)	.05 lb.
Copper carbonate, dry.....	.23 lb.	Spelter, see Zinc.	
Copper, sulphate (blue-stone).....	.12 lb.	Sugar of lead, see Lead acetate.	
Copper trisalyt	.30 lb.	Sulphur (brimstone), in lump.....	.06 lb.
Copper cyanide	.45 lb.	Tin chloride	.43 lb.
Corrosive sublimate, see Mercury bichloride.		Turpentine, spirits of	.55 gal.
Cyanide, see Potassium cyanide.....	.30 lb.	Verdigris, see Copper acetate.	
Dextrin	.15 lb.	Water-glass, see Sodium silicate.	
Emery flour	.05 lb.	Wax, beeswax, yellow	.30 @ .33 lb.
Emery, F F & F F F.....	.03 lb.	Wax, carnauba	.45 @ .47 lb.
Flint, powdered	25.00 ton	Whiting (ground chalk)	.05 lb.
Fluorspar	30.00 ton	Zinc, carbonate, dry	.25 lb.
Fusel-oil	3.35 gal.	Zinc, chloride	.15 lb.
Gold chloride	11.75 oz.	Zinc cyanide	.35 lb.
Gold trisalyt	10.00 oz.	Zinc, sulphate	.07 lb.
Iron perchloride (110 lb.).....	.20 lb.	Zinc (spelter)	.22 lb.
Iron sulphate (copperas)	.05 lb.	Zinc, trisalyt	.28 lb.
Lead acetate (sugar of lead).....	.17 lb.		

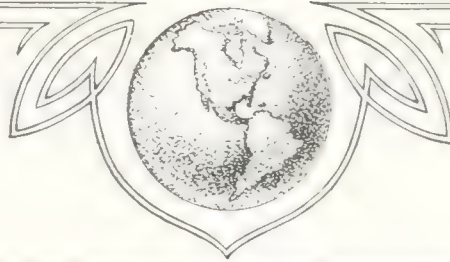
OLD METALS MARKET

At the time of going to press, Sept. 15, prices of old metals, paid by the metal dealers, are as follows:

Heavy copper scrap.....	14 to 14¾	Scrap zinc	8½ to 9
Light copper scrap.....	12½ to 12¾	Clean old sheet and cast aluminum scrap.....	25 to 27
No. 1 machinery comp.....	11½ to 11¾	Clean new sheet aluminum clipping.....	29 to 31
Heavy brass	9 to 9½	Heavy lead scrap.....	.04
No. 1 composition turning.....	11½ to 11¾	Electrotype	.04½
No. 1 brass turning	11½ to 12	No. 1 pewter	22 to 23
Brass clippings	12½ to 12¾	Sold joints close cut.....	7 to 7¼
Old light brass scrap.....	7 to 8	Cocks and faucets.....	10 to 10¼

The Brass World & Platers' Guide

Volume XI
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A Monthly Journal Devoted to the Art of Refining, Alloying, Casting, Rolling Founding and Electroplating of All the Non-Ferrous Metals and their Alloys

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Sessions of the American Institute of Metals

The annual meetings for 1915 of the American Foundrymen's Association and the American Institute of Metals opened at 10.45 a. m. Tuesday, Sept. 28, in the convention hall on Young's Million Dollar Pier. An address of welcome was presented by Henry A. Carpenter, General Fire Extinguisher Co., Providence, R. I., and was responded to by J. P. Pero, Sr., Missouri Malleable Iron Co., East St. Louis, Ill., who in the course of his talk advocated a closer union between the American Foundrymen's Association and the American Institute of Metals. The outstanding features of the joint meeting were a discussion of the report of the A. F. A. committee on industrial education presented by Frank M. Leavitt, chairman, University of Chicago, Chicago, Ill., in which Major Speer, Mr. Seaman and several other members took part. The paper on molding sands by C. P. Karr, associate physicist Bureau of Standards, Washington, D. C., was also well received, and was responsible for the appointment of a committee with Dr. Moldenke as chairman to represent the A. F. A. at the conferences of the A. I. M. and several other societies in their scheme of co-operation with the Bureau of Standards, Washington, D. C., to the end that foundry problems may be more scientifically investigated.

The regular sessions of the American Institute of Metals commenced on Tuesday afternoon at 2.25 p. m. The meetings were held at the Hotel Traymore and were exceptionally well attended. The first paper on the program was entitled "An Investigation of Fusible Tin Boiler Plugs," by Dr. G. K. Burgess and Dr. Merica. The investigation showed that none but the purest grades of tin should be used for such a purpose, otherwise, oxidation would set in and by making the tin non-fusible would defeat the purpose for which such plugs were used.

Interesting discussions followed the reading of the paper entitled "The Influence of the Impurities of Spelter on the Cracking of Slush Castings," by Gilbert Rigg, New Jersey Zinc Co., Newark, N. J., and the paper entitled "Standard

Test Specimen of Zinc-Bronze: Copper, 88; Tin, 10; Zinc, 2, etc.," by Dr. H. S. Rawdon, Bureau of Standards, Washington, D. C. The first paper showed that cadmium was a very injurious impurity in zinc intended to be used in making slush castings as it caused them to crack.

The second meeting was held on Wednesday morning, and after several papers had been read and discussed the report of the nominating committee was heard and acted upon. The presidential and secretarial offices were filled as follows: Jesse L. Jones, president; W. M. Corse, secretary-treasurer. The afternoon session was devoted to papers treating of aluminum and aluminum alloys, Thursday morning to papers on acid metals and bearing bronzes, and Thursday afternoon to forging and rolling alloys.

There were few of the papers that did not give rise to discussion, all of which seemed interesting, although not all of it in a general way. It would be a difficult matter, of course to get up a paper that would interest each one individually because all are not equally interested in the various problems that arise, but it would expedite the transaction of business a great deal, and probably permit of the presentation of more papers, if that were desirable, if the discussion of papers interesting to only a small minority was adjourned to a separate room convenient to the main assembly room. This could be accomplished by a rising vote, and the business of the meeting could then go on. There is nothing more tedious to the average person than to have to sit through a long-drawn-out discussion on an uninteresting subject, simply because there is something in which he is interested further on the program. The paper on sherardizing might be cited as an instance. Now sherardizing is a very interesting subject to those engaged in such work, but how many foundrymen do sherardizing? The consequence was that the majority of the audience that heard the paper while mildly interested at its reading, found the long discussion very tedious. In making these remarks there is no intention of criticising the paper; it was a valuable one and should have a place

in the transactions of the institute. The discussion also brought out some interesting facts, but we venture to assert that had it been the last paper on the program of the session, the audience would have been very considerably thinned before the discussion was over. We believe that if this problem could be solved to the satisfaction of all parties the meetings of such societies would become much more interesting to the rank and file of the membership.

The 1915 Foundrymen's Convention

The great event of the year from the foundryman's standpoint—the convention of the allied foundrymen's organizations—is now past history, and there is no doubt but that it was as great a success as the ones previously held, although the attendance appeared to be less than in Chicago, probably owing to the fact that many foundrymen were too busy to get away from the daily grind. Those who did attend, however, appeared to combine business and pleasure in a very satisfactory manner, as the exhibit was thronged by interested crowds during the day, and the evening entertainments were immensely enjoyed.

A pier, however, does not appear to be an ideal place on which to hold such an exhibition as it is a long and comparatively narrow structure built on piles extending over the ocean, and while it might have been strong enough, the working machinery caused considerable vibration, and it was noticeable that the jarring machines were not operated to the same extent as if they had been on terra firma. Still there was considerable molding done to visualize the working of improved machines, and to illustrate the handling of difficult patterns, but there was no pouring off except in one booth in which an electric furnace was being demonstrated, and this exhibit was reduced to still life at the most interesting phase of the exhibition on account of the low roof, which afforded no exit for the smoke, and remained so until some bright genius solved the problem by removing a section of the roof directly over the furnace, when further heats of steel were poured and everybody felt happy. Other

operating exhibits were sand blasting, arc welding, acetylene welding, power metal cutting, sand screening and cutting over, power ramming, grinding, etc. The heavy machinery and the operating exhibits were located as nearly as possible at the land end of the pier, with the still exhibits at the ocean end. The exhibition was therefore somewhat strung out, and for this reason was not as impressive as when gathered in one hall, as for instance at the Buffalo convention. But for all that many of the exhibitors expressed themselves as being well satisfied with the amount of business done, or in prospective; for although the beginning was poor it was made up for later on.

It was fortunate that fine weather prevailed the greater part of the week, as the section of the pier on which the still exhibits were housed is not glassed in at the sides, but was merely inclosed with unbleached muslin to admit the light and afford protection in case of rain, but which would not withstand much wind. Consequently, when Friday broke with a high wind and a driving rain, some of the still exhibits, especially those located on the side of the pier exposed to the wind, experienced such discomfort that the exhibition could not be said to have closed in a blaze of glory for them; in fact they were not sorry to pack up and get out. There was no complaining, however, as everyone felt glad that this had not happened on the first day or had continued a day or so. The rest of the week the weather had been sunny and warm, although not so warm that the majority had preferred the delights of bathing and the beach to visiting the exhibits and attending the sessions; these latter had first place, and the consensus of opinion, as we heard it, appeared to be that the Atlantic City Convention was one to be long remembered because of the many pleasing and novel features introduced consequent on its being held at a great seaside resort.

The use of such metals as paladium, rodium, osmium, rothinium, and iridium, all of which belong to the platinum group, as alloys, enabled the platinum to be described as pure.

The Value of a Knowledge of Metals

Bronze is an alloy of copper and tin with small amounts of zinc, phosphorus, manganese or any other element capable of serving the purpose of a deoxidizer and thus insure castings free from porosity.

It is a strong, tough alloy, rather difficult to machine, and adapted for castings where strength or ductility is required. Bronze is closely imitated, as far as external appearances are concerned, by red brass, which is an alloy of copper and tin, and lead and zinc in varying proportions. The color of some red brass alloys is more pleasing than that of bronze, while others more nearly approach that of brass, depending upon whether lead or zinc plays the leading rôle, and in what proportions they may be present. When the zinc content is higher than 10 per cent the alloy rapidly yellows to the color of yellow brass; in fact it becomes a yellow brass, and no advantage is gained by keeping the zinc low and trying to regard it as a red brass, as the color gives it away and it has to be sold as such; therefore, the zinc might just as well be doubled and advantage be taken of its cheapening effect, when the price of this metal is normal. With the zinc at 10, lead about 3, and tin around 2 per cent, balance copper, a very ductile alloy results which finds extensive application for many purposes.

Another very useful alloy often regarded as a steam metal is the well known "ounce metal," so called because it consists of 1 oz. each of tin, lead and zinc to 1 lb. of copper. It is a good conservative alloy that can be used to advantage for many small castings, and the formula given need not be strictly adhered to, as there is considerable latitude for varying the proportions of the white metals either way. The following analysis is that of a basin cock made by one of the leading manufacturers of plumbing goods, and illustrates this point. The alloy follows:

Copper	87.55 per cent
Lead	4.00 per cent
Tin	3.60 per cent
Zinc	4.85 per cent

Red brass does not always contain tin. An alloy extensively used for very small

brass castings consists of 84 per cent of copper and 8 per cent each of zinc and lead. It is a soft, somewhat ductile alloy that is machined with great ease, and therefore very suitable for certain small brass parts, as it favors economical production and at the same time answers just as well in the situations in which it is used as the more expensive alloys.

To be able to decide whether red brass or bronze should be used and just what particular alloy will best fill requirements, is frequently a distinct advantage to the small jobbing brass founder, as it may be the saving of considerable money, as the following incident will illustrate.

Some years ago a molder and his friend formed a partnership and invested their savings in starting a small jobbing brass foundry. The molder was a thoroughly practical man as far as the sand pounding end of the business was concerned, and believed he knew about all there was to know about "metal mixing," because previous to embarking on the uncertain sea of business, he had held down the job of boss brass molder for a large corporation who made brass castings for their own requirements only, in a small foundry in which he and a boy were the only persons employed. The work consisted largely of bearings, with some few smaller castings of a miscellaneous kind, and the alloys required were "phosphor bronze" and "gun metal," as they were called, and consisted of 80-10-10 phosphorized, and 88-10-2. These two alloys comprised about all our molder knew about metallic alloys, as he had no occasion to use red brass, and previous to going to work in the brass shop had served the same company for several years in the capacity of bench molder in the steel foundry. He was, consequently, quite seriously handicapped when he entered the jobbing brass foundry business, although he was unaware of the fact. His partner looked after the office and outside work, and for a year they were fairly prosperous owing largely to the fact that the corporation where the molder was formerly employed closed its little foundry and turned over all its work to the former molder, and this was

about all they could handle for several months. So while they did not prosper exceedingly, they held their own and made a living, but like all the rest of us they were ambitious to grow and began reaching for outside business, and as the partner was no chair-warmer they soon got as much as they could handle with their small capital. The new business was of an entirely different character to which they had been accustomed, in fact it was more desirable had they known anything about red brass alloys and the judicious use of scrap metals, as there were no specifications to work to; all that were needed were clean presentable castings that would machine easily. The boys, however, were sublimely unconscious of the requirements of the case, and filled the order with good old 88-10-2, proudly dilating on the fact that it was all new metal, that they did not use scrap. To say that they were astounded when the castings all came back with the complaint that they were "too hard" would be putting it very mildly. It was a bitter disappointment, and they could not understand it, as they had given these people the "very best metal," therefore, they must be exceptionally hard to please. They soon found, however, that these were not the only customers that were hard to please. The "hardness" of the metal became a fruitful cause for complaint, and so many castings were returned that they began to lose money and continued to do so until a point was reached where something had to be done, so a specialist in non-ferrous metals was called in for consultation who, after being put in possession of the facts in the case, pointed out their mistakes and coached them in the art of alloying metals for different commercial requirements. The result was a reorganization of the business and a new start under more favorable auspices as far as knowledge of the business was concerned, and the thing ultimately turned out well, but much loss, anxiety and recriminations could have been avoided by a little more knowledge of brass foundry alloys, and their suitability or otherwise for various kinds of castings.

Both red brass and bronze have their own special uses and their own fields to fill, and so have scrap or secondary metals, as they are now called. The foundry that uses no scrap has a hard row to hoe in competition with one where the judicious use of scrap is understood. A knowledge of the proper use of alloys, both new and old, plays a most important part in the success of a brass foundry. As one veteran foundryman put it, "There's more to be got out of the metals than out of the bones of the molders," and the man who understands this best makes the most successful foundryman.

◆ Detecting Impure Platinum

A serious source of uncertainty in analytical chemistry has been eliminated by recent experimental study of the U. S. Bureau of Standards. In the steel laboratories as well as in others annoying results due to impure platinum crucibles have been frequent. The bureau has developed a delicate thermoelectric test for platinum purity which permits a rapid estimate to be made of the amount of included foreign matter, such as iridium or iron, without affecting the articles tested such as crucibles, wire gauze, dishes, etc. This thermoelectric test is being adopted generally by large buyers of platinum ware. From the results of the investigations it is now possible to predict very closely what will be the loss in weight of a "platinum" crucible when heated, thus eliminating a serious uncertainty. Ordinary grades of platinum are found to lose from 0.7 to 2.7 milligrams per hour per 100 sq. cm. of surface at 1200 deg. C. Curiously enough the small amounts of iron always present in platinum are found to bear no simple relation to the magnetic properties. Scientific Paper No. 254 of the Bureau of Standards elucidates this subject.

◆
The ill-fated Quebec bridge is now being melted down by the Canadian Car and Foundry Co. for use in making shrapnel. The mistake of the civil engineers is furnishing additional employment for the metallurgist.

◆
One who treats the black precipitate from the cyanide process is not a gold smelter. He is a gold refiner.

THE ALLIED CONVENTIONS

The Annual Conventions of the American Institute of Metals, and American Foundrymen's Association, in conjunction with the Exhibition of the Foundry & Machine Exhibition Co. Atlantic City, September 25th to October 1st, 1915.

The deliberations of the societies, which was the real beginning of proceedings, was opened on Sept. 27, when

one, when the following papers were read and discussed: "Tests of Lenses for Foundry Goggles," "Functions of



Banquet of the American Foundrymen's Association and

registration was in order. The Institute of Metals met in the Hotel Traymore, while the American Foundrymen's Association assembled on Young's Million Dollar Pier.

The meeting of Tuesday was a joint

Sand Binders," "Notes on Applications and Characteristics of Cores in Modern Molding" "Molding Sands," and "Albany Molding Sand."

The same day in the afternoon the Institute of Metals considered the follow-

ing papers: "An Investigation of Fusible Tin Boiler Plugs," "The Effects of the Common Impurities in Spelter upon Slush Castings," "Standard Test Specimen of Zinc-Bronze, Copper 88, Tin 10, Zinc 2," "Relation of the Mechanical Properties to the Microstructure."

The papers read before these organizations on the above and subsequent days of meetings have been listed, with the names of the authors, in our August issue. Some of them are printed in this issue of BRASS WORLD, and fol-

the circumstance that business of a hurried nature kept many at home who usually make it a point not to miss these meetings. But enough were present to maintain all the characteristics of these important annual assemblies.

REPORT OF THE SECRETARY-TREASURER

The report of the secretary-treasurer of the Institute of Metals follows:

Our membership ending July 1, 1915, was 314. Twenty-two members have resigned and we have received twenty-two



The American Institute of Metals, Hotel Traymore, Atlantic City

lowing numbers will spread before our readers all of them that seem to affect their interests or that may show the trend of the technical thought of the trade.

The attendance was large in view of

applications since July, making our total membership to date 314.

The increase in dues has met with a very gratifying response. One hundred and seventy members have sent in their checks to date, indicating that the bound

volume of transactions is worth the amount that we charge for it.

Volume No. 8 has been very favorably received and is without doubt our best volume up to the present time.

Those of us who were fortunate enough to attend the Chicago meeting last year realized the strength of the program and the enormous amount of work done by Dr. Gillett in preparing it. It is, therefore, with a great deal of gratification that I am able to state that this year's program is on the same high plane and bespeaks a lot of work on the part of Jesse L. Jones, chairman of the Papers Committee.

In the secretary's work it is also very gratifying to be able to record co-operation of this kind, for it certainly is a great help in many ways.

During the year we made an arrangement with Charles Vickers, who is a member of the Publication Committee, to edit the Transactions. As Mr. Vickers is situated conveniently with reference to the secretary's office this makes a very good arrangement, and I think you will agree that Volume No. 8 bears this statement out.

The co-operative work with the Bureau of Standards has been progressing satisfactorily, a meeting having been held during April of this year with another one planned for October. The papers by men from the Bureau of Standards, presented at this meeting, indicate the scope of the work that the Bureau is undertaking. The members of the American Institute of Metals Committee meeting with the Bureau of Standards feel that the work is well worth while, and are very glad to be able to record the feeling of the Bureau officials to the same effect.

The following is the standing of the books on July, 1, 1915: Receipts, \$2,-571.31; disbursements, \$2,266.31.

The Committee on Nominations presented the following ticket, which was elected:

President, J. L. Jones, Pittsburgh; secretary-treasurer, William M. Corse, Buffalo; vice-presidents, R. S. B. Wallace, Dayton; G. C. Stone, D. B. de Courcy Brown, New York; W. B. Price, Waterbury; E. H. Barnes, Fort Wayne; G. K. Burgess, Washington; F. H. Shutz,

Decatur, Ill.; W. G. Harris, Toronto; E. B. Horne, Detroit.

The American Foundrymen's Association elected the following officers:

R. A. Bull, president; A. O. Backert, secretary-treasurer, Twelfth and Chestnut streets, Cleveland; vice-president, H. E. Field; senior vice-presidents, Henry A. Carpenter, Walter Wood, S. B. Chadsey, T. W. Sheriffs, J. P. Pero, Sr., A. T. Drysdale, H. B. Swan, A. H. Thomas, B. D. Fuller.

All of this board of officers, excepting two vice-presidents, succeeded themselves.

THE FOUNDRY AND MACHINE EXHIBITION

Young's Million Dollar Pier was occupied to its available capacity with a splendid array of machines, apparatus, etc., that were fine examples of the progress of the arts of working in metals. Many exhibitors demonstrated their exhibits in motion, which gave an animated and exceptionally interesting air to the entire display.

Goldschmidt Thermit Co.

The space of the Goldschmidt Thermit Company of New York was a very busy place and an attractive one. The operation of the production of various pure, carbon-free metals, experimentally from their oxides, was a daily occurrence. Manganese, chromium, cobalt, titanium, etc., were some of the non-ferrous products acted upon. There were examples of 50/50 nickel copper, 15 per cent phos. copper, 5 per cent phos. tin, 10 per cent silicon copper, 10 per cent titanium copper, pure carbon-free manganese metal, 10 per cent cobalt metal, etc., etc.

Thermit welding was in operation on steel, wrought iron, etc. Welding new gears in place of broken ones, pipe welding and other practical work was done as a means of showing the apparatus employed and how neatly and how perfectly the welds could be made.

The company had about ten representatives present. Those directing affairs were Mr. de Courcy Brown (who has been elected vice-president of the A. I. M.), William Aldrich, H. D. Kelley from the New York office, and J. S. McCarty of Toronto and H. G. Spillsbury of Chicago.

Joseph Dixon Crucible Co.

The exhibit of this company displayed crucibles, stoppers, stirrers, etc. So far, we were told, there has been no change in the established formulas used in the making of crucibles, but possibly time and changing world trade conditions, as the cutting off of shipments for one thing, may cause the use of American plumbago, but there will be no substitutions of native clays.

The following staff of representatives were kept busy: Frank Krug of Philadelphia Branch was in charge, with the able assistance of Messrs. Leonard and Moses of New York, John Condit of the Buffalo Branch, Messrs. Seitz and Henry Armstrong from Jersey City, Mr. Sorenson, Chicago, Mr. Haasis, Eastern representative.

The course of business was lightened now and again by the presentation of a miniature, comical Charlie Chaplin "lid," which the visitor thought was "a hit, sir, a palpable hit!"

Ajax Metal Co.

Various mixes were displayed with test pieces. These pieces being rough on one side, machined on the other side. The demonstration was to prove that the test pieces contain tensile strength, elastic limit, elongation and reduction of area. There was also given out data on compression strength of the various metals. The castings exhibited were pieces loaned by customers using the Ajax ingot metal, and show what customers are making from the various metals. There were also fluxing alloys, phosphor copper, phosphor tin, silicon copper, manganese copper being used for deoxidizing, etc. The well-known Ajax babbitt metal was on display in small quantity, as well as an aluminum composition for making patterns. These were fine examples of die-casting work made from their metals. One of the castings especially worthy of note was a large submarine engine base of manganese bronze, 8 ft. by 22 in.

Another casting which excited a good deal of interest was a fire pump for fire engines, made to carry 400 lb. pressure. One of the factors of Ajax ingot is the Ajax process of manufacture for eliminating oxide from the metal, thereby giving a better product and a high yield.

Effect of the Present War on the Metal Industries

THOMAS FORRESTER WETTSTEIN.*

A year of world-wide war, with its early shock to all financial exchanges the world over, forcing a complete cessation of business in these exchanges for many months, accompanied by a thorough demoralization of the intricate exchange operations between the capitals and commercial centers of the world, must necessarily have a tremendous effect upon all metals and particularly those whose use make modern warfare possible.

Without attempting to analyze this effect upon metal values in the warring countries, it is quite sufficient to speak only of the year's record of the American metal markets, since their fluctuations are reflected in values not only here but the world over.

The value of the products of the metal industries in this country is approximately 20 per cent of all American industries, from which some idea may be gained of their importance. Their economic value is, however, much greater, since metals are used so largely in all constructive work.

The non-ferrous metals, being of much smaller tonnage and used so largely in modern warfare, were subjected to the widest fluctuations ever known as a direct result of the war. Copper, the most important of these, is an ingredient of brass so largely used for ammunition. Its use for this purpose is probably of such large volume as to offset the diminished demand for constructive work in the warring countries. This is plainly reflected in the prices for the metal in America, where the largely increased production has only lately made itself felt in a moderate recession in price from the high point reached in June.

Zinc, another ingredient of brass, and so largely used in galvanizing in constructive work, is in a class closely related to copper in so far as the demand is affected by the war. There is this difference, however, that while America is the largest producer of copper in the world, the production of zinc is normally

*Read before the Annual Meeting, American Institute of Metals, Atlantic City, 1915.

more widely scattered, and Germany is a very important factor in its production. The German exports of this metal having ceased, a heavy strain upon American production instantly made itself felt, with the highest prices on record as an immediate result. Still another factor contributing largely to the famine prices for this metal in June was the fact not generally known that for cartridge brass one or two exceptionally pure brands of zinc alone could be used, because of the presence of a percentage of lead in the more common brands used for galvanizing. Ammunition manufacturers were compelled to use the fancy brands for their work and found themselves unable to cover their contracts by the purchase of sufficient supplies. It is natural to suppose, therefore, that hedging operations—the purchase of the common brands for price protection but not necessarily for consumption—were frequently undertaken, the metal to be sold to galvanizers or others as higher prices had to be paid for fancy brands when put into consumption. The premiums now existing for these fancy brands plainly show that these hedging operations, if carried on, were only in small part successful in attaining their object.

Lead, used so largely in constructive work, becomes also a very important factor in the destructive work of war. Here as in copper, however, it is thought that the increased consumption for war material is easily offset by the diminished demand in constructive fields. Present prices appear to confirm this reasoning.

Tin finds its uses chiefly in alloys of which solder and babbitts are perhaps the largest items. But little of this metal finds its way to war, so that the wide fluctuations in its price during the past year must be attributed to other causes. The Straits Settlements produce the largest part of the world's supply of tin, and the high prices for this metal ruling late last year were probably due to the activities of the German cruisers then roaming the eastern seas. A number of heavily-laden vessels carrying tin were sunk, and on such occasions the markets immediately responded by violent advances. There have been no such inter-

ruptions to the tin traffic in the last six months, and prices for this metal have steadily declined, the ordinary commercial demand seemingly not keeping pace with the production. This metal is normally highly speculative, and in ordinary times, fluctuations have been quite as severe and sudden, and covering as wide a range as during the past year. It is quite within safe bounds to say that of all metals, tin is least affected by the present war.

Antimony, a minor metal, but one used largely in alloys for bearings and for type, is the one metal seriously affected by the war. Its production is chiefly in the East, China and Japan, together, contributing the largest quota. The Mexican production was at one time very considerable, but because of the internal troubles of that unfortunate country, it ceased to be a factor some two years ago. The annual production of this metal in times of peace is scarcely twenty thousand tons, all of which is consumed in constructive work. But the war has made heavy demands upon the supply, and very large tonnages are used for hardening bullets. No new sources of supply of any consequence have been found, so that the prevailing price of approximately 30 cents in New York, as compared with 6 cents thirteen months ago, seems to be amply justified. It is perhaps the only metal of the non-ferrous type, of which it can be definitely stated that its present high price is directly attributable to the war.

To summarize, one may easily conclude that the non-ferrous metals, with the sole exception of antimony, while undergoing at times wild fluctuations because of urgent covering operations attending the placing of war contracts, in the end will have been found fairly stable in values, largely due to the equalizing influence of the war demand with the greatly diminished demand from the fields of peace. Moreover, the deposits of these metals in America are of such large areas that production may well be kept in line with the changing demands. Antimony, however, cannot be so classified and, unless new deposits are found, this metal must continue scarce so long as a war demand exists for it in its present volume.

Melting Aluminum Chips

H. W. GILLETT.*

This paper is written at the request of the chairman of your papers committee, and is based on some recent work which will be published in full as a technical paper of the Bureau of Mines. Since a fuller account will soon be available, the present paper aims to deal with the subject only in a brief and sketchy manner.

If a foundryman attempts to melt down the No. 12 alloy chips made in machining aluminum castings for automobiles in the same way he would melt brass chips, either by adding them in small amount to a pot of metal, or melting them alone, he usually gets somewhere between 50 and 70 per cent of the chips into a pool of metal in the bottom of the pot and from 30 to 50 per cent into a light fluffy dross that, as soon as the air strikes it, gets excessively hot, glows with a blinding light and smells of ammonia when moistened.

One naturally supposes that the cause of this dross formation is the great affinity of aluminum for oxygen and that the dross, i. e., the loss, comes from oxidizing conditions within the furnace. The foundry magazines in their "asked and answered" columns, tell us every month or so that to melt aluminum borings one should get a pot half full of molten metal and then stir the borings in so as to cover them with metal and keep the air away from them, finally fluxing with salammoniac or zinc chloride. The trouble is that the borings prefer to stay on top and refuse to be stirred in.

If the borings are, and those from most machine shops almost invariably are, contaminated with even two or three per cent of fine dirt, such as floor sweepings, one can melt in a closed retort, or in an electric furnace in the entire absence of oxygen, and still get very low recoveries and copious amounts of dross.

The real trouble lies in the fact that a large proportion of the chips are only about 5/1000 of an inch thick, and will pass a 20-mesh riddle. When such a chip melts it forms a globule of metal

about as big as a pin point. Each chip has had an infinitesimally thin film of oxide on it, formed the moment it was cut. That such thin films prevent metallic contact between aluminum surfaces is plain from the fact that a bundle of aluminum wires may be twisted together and brought up to the fusion point without welding together at all unless they are forced together so that the film is ruptured or unless a flux that will dissolve aluminum oxide is used.

Each little pin-point globule is then surrounded by a film of oxide, infinitesimal in thickness or weight, but yet sufficient to keep the globules from uniting. If any fine dirt is present, this reinforces the oxide armor and makes matters worse.

So our dross, instead of being mainly aluminum oxide, is mainly tiny globules, separated by films of oxide and dirt. Were this not the case, and were the dross all oxide, it would not get hotter on striking the air when skimmed off. Thus, while the cold dross is oxide, the hot dross is an emulsion of metal droplets kept separate by a solid honeycomb-like structure of oxide and dirt.

The problem is then, mainly one of getting these tiny droplets to coalesce and to free themselves from the dross. The common method is to stir salammoniac or zinc chloride into the dross. These "fluxes," so-called, are really mainly stirrers. They gasify at temperatures below the melting point of aluminum and the violent evolution of gas tosses the mass of dross about, throws some of the globules together with such force that the enveloping film is ruptured and a few of the globules coalesce. But the volatile fluxes are not very efficient stirrers and the dross, after they are used, still burns up in the air almost like a flash-light powder, because of the metallic aluminum still left in it.

It is, of course, desirable to melt in a reducing atmosphere, if possible, but oxidation within the furnace is far less troublesome and far more readily overcome than the reluctance of the globules to coalesce.

Many methods of melting chips have been suggested, ranging from the use of vacuum furnaces to that of patent fluxes with enticing names at 25 cents

*Paper presented at the Annual Meeting of the American Institute of Metals at Atlantic City, 1915.

per pound. Space is lacking to go into all these here. Two methods, both of which aim to promote coalescence, are in use by two firms refining aluminum chips on a large scale, and give good results.

The first of these is the "puddling" process. Melting is done in oil-fired furnaces, using iron pots, the furnaces being provided with close fitting hoods. The empty pot is heated up to a low red, and a few shovels of chips put in. The furnace tender stands by with a big skimmer and works the chips over constantly till they start to get pasty. Before they are fully melted, he adds another small dose of chips and works that into the dough-like mass. The mass is not allowed to get visibly red. The addition and the working over of the chips is continued till the pot is full, holding the temperature practically at the melting point. By the constant stirring of the pasty mass, the tiny globules are pressed together, and the films of oxide and dross broken through, so that the result is a uniform pasty mass of metal, enveloping particles of dirt and oxide instead of a little molten metal below and a mass of dirt and oxide enveloping globules above. The pot is then covered and the metal heated to about 700 deg. C. or 1300 deg. F. till the dirt and dross rise.

Zinc chloride is then stirred into the risen dross, and the dross skimmed rapidly into water so as to stop oxidation and allow the recovery of entrained metal.

This method gives about 70 per cent recovery on the ordinary dirty borings of commerce. On borings cut with a water-soluble cutting compound, if the wet borings are allowed to dry out in the air, to oxidize and cake up, the recovery by this method is 50 to 60 per cent. But if these borings are very carefully kept free from dirt and are promptly dried, after cutting, by centrifuging, these clean, dry borings give 85 to 90 per cent recovery by this process.

The puddling process requires the constant attention of the furnace tender, and the daily output per man is small.

The other process is based on the same principle as that of welding aluminum, where fluxes composed of chlorides and

fluorides of the alkalies or alkaline earths are used to dissolve the film of aluminum oxide and to allow the metal surfaces to unite, fluorides being the best known solvents for aluminum oxide as well as good ones for siliceous dirt. The chips are intimately mixed before charging with large amounts (20 to 50 per cent of the weight of the chips, depending on the degree of cleanliness of the chips) of a flux consisting of about 85 per cent common salt and 15 per cent powdered fluorspar. The mixture of chips and flux is put into large crucibles, heated in a coke fire. As soon as the chips start to melt, they are jammed down to make room for more mixture, and so on till the pot is full.

The pot is then left undisturbed without stirring, till the flux is fully melted, and fluid enough to absorb, either by true solution, or by soaking it up mechanically, the oxide and dirt, and to allow the tiny metallic globules to fall through it and collect in a molten mass. This requires at least 900 deg. C. or 1650 deg. F.

On absolutely clean borings, this method gives 90 to 95 per cent recovery, while chips very foul with dirt may give but 65 per cent.

This method cannot be used in iron pots because the temperatures required are too high for reasonable pot life. It will probably require more fuel than the puddling method because of the higher temperatures and because so much flux must be heated up. The flux, though it has to be used in large amounts, is so cheap that it is hardly more expensive than the zinc chloride used in the puddling method. The crucible expense will be a little higher than that for iron pots in the puddling method, but the labor cost should be very much lower.

Moreover, it is quite possible that by increasing the amount of flux to correspond with the greater surface of the metal bath in a reverberatory than in a crucible, that the salt fluorspar flux method might be used in reverberatory melting.

On tests of a lot of commercial borings containing some ten per cent of very fine dirt, the average recoveries, figured on the true metallic content of the chips, were as follows:

	Gas-fired Crucible Furnace, Per Cent	Electric Crucible Furnace, Per Cent	Small Gas-fired Reverberatory, Per Cent
No flux			
Volatile fluxes, sal-ammoniac, zinc chloride, etc., with stirring but without con- stant puddling	65-70	70	50-60
Retorting or stirring into molten metal	65-70	..	.....
Briquetted chips stirred into molten metal	75	..	.....
Puddling process	70-80	..	.....
Salt fluorspar flux	75-85	85	80-90
Briquetted chips with salt fluorspar	90	..	.....

Experiments indicated that dirty, oily borings might be cleaned by washing with a weak caustic soda solution, perhaps freed from dirt on a concentrating table and dried by centrifuging, but whether such cleaning would pay commercially is a question. It is also an open question whether briquetting will pay commercially.

But it is certain that keeping the borings scrupulously clean and free from dirt or dust, keeping them free from contamination by iron or brass chips, and centrifuging off water soluble cutting solutions, are advisable, and that the higher recovery from clean chips will pay richly for a little extra care in the machine shop.

Up to say 25 per cent of ingot obtained from borings by either the puddling or the salt-fluorspar process can be used in many simple castings without detriment to the quality or strength of the castings and without increase in foundry defectives. If iron is kept out the composition will not change materially in refining, and, if desired, a furnace or two can be kept busy on borings, and the molten metal mixed in the desired proportions with new metal from other pots and castings poured direct from the mixture without having to ingot the metal from the chips for later remelting.

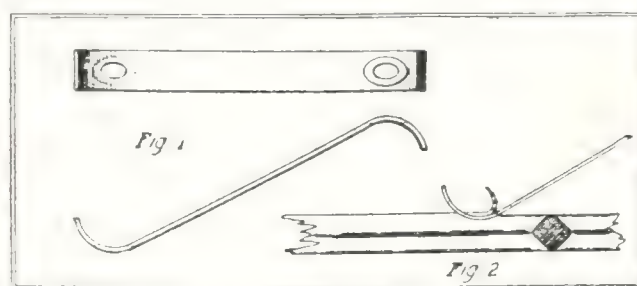
Difficult Small Castings

Occasionally the experimenter has need of small castings of intricate shape which would hardly warrant the making of core prints. The pattern is first made in wax procured from any dentist

or dental supply house and carved into proper shape with the aid of a slightly warmed knife. It is next smoothed down to a glossy finish with gasoline or commercial chloroform applied with a pledget of cotton. Then a mixture of one part sharp sand and three parts plaster of Paris is made and the pattern covered with it. This investment should have just enough water in it to make a thick, creamy mass. Cut a pouring vent through the plaster so as to expose the wax. Place the investment in boiling water until all wax is out of the mold and heat in oven till very dry, then pour the metal through vent. It is an advantage to make one or two air vents to allow the steam and gases to escape when pouring.—*Popular Science Monthly*.

Pattern Maker's Tool

While walking through a factory a patternmaker was observed using a very handy tool. The device enabled him to round the edge of a pattern, taking off the corners a little bit at a time and with the greatest ease.



The tool was made from a piece of 1/16-in. strip steel about 3/4 in. wide and 7 in. long. The strip was bent into a long "S" shape as shown in the illustration, and the two holes, one in either end, ground in the curved portion to form an elliptical opening with a cutting edge. The size of the hole determines the radius of the curve which is to be cut in the rounded corner of the pattern. It is, therefore, advisable to make up a number of the tools fitted with different sized openings in order that various classes of work may be accomplished. The method of using the tool is clearly shown in the illustration.—*Popular Mechanics*.

Cleaning Metals

By E. S. THOMPSON

The importance of cleaning the base metal preparatory to receiving an electro-deposit is too often overlooked by the heads of manufacturing establishments. True, cleaning is being done successfully in all plating-rooms or successful deposition would be impossible. But how is it done? Is there any thought given to preserving the surface of the metal and eliminating mechanical cleaning, such as scrubbing?

In the majority of the plating plants there is no economy practiced. The old method of scrubbing with brush and pumice stone is followed, destroying the luster of the base, making the final finishing operation on the buff hard to accomplish, necessitating a much heavier deposit of the finer metal. Then there is risk of cutting through the deposit on the corners, imperceptibly at first, but showing up after the article has been placed in stock for a few days.

The writer was employed by a large concern and the plating department was absolutely under his management. He found that the buffers had been taking time to color all brass and bronze bases which were to receive a deposit of another metal. These highly finished articles were immersed in a solution of caustic soda until they became tarnished, and were then scrubbed with brush and pumice. As the coloring operation was a waste of time under these conditions, the coloring was discontinued until arrangements could be made for a cleaning compound which would remove the grease without destroying the luster of the metal. This proceeding was followed by an employee who did not understand the technicalities of plating, "knocking" to the superintendent (who was likewise ignorant), that the boss was making his work harder by not coloring the work.

When the purchasing department was finally persuaded to buy a cleaner which cost a cent more per pound than the soda, the coloring operation was again taken up, and scrubbing with pumice discontinued, washing the work with a cotton brush and the cleaning solution. This brought a "kick" from the manager, who had been told that the new cleaner would eliminate the scrubbing operation, the manager not knowing the difference in the two operations until it was explained to him.

In another plant where cast iron was plated, the writer installed an electric cleaner. In this plant there was not sufficient heat to remove the grease with any cleaner and scrubbing was a hard, tedious job, and stripping of the deposit very often occurred.

When the electric cleaner was installed there was also a tank of warm cyanide solution placed near the cleaner to remove any foreign substances which might be deposited from the cleaning solution. Even with this equipment failures would sometimes occur, owing to the operator being unable to distinguish between cast iron and an oxide, and he would remove the work from the cyanide solution before it had been made chemically clean.

The superintendent in this plant would listen to "knocks," and he reprimanded the writer for using an electric cleaner and cyanide, saying that he had been told that the electric cleaner would eventually spoil the plating solutions, and that cyanide did not belong in that business!

What is a foreman plater to do to increase the efficiency of his department when every improvement is fought?

If an improved cleaner is bought and the directions say "work the solution boiling-hot," and no means of heating the solution to the boiling point are to be had, should the foreman be blamed because the work is not cleaned economically?

There are cleaners on the market which will clean work without affecting the surface, and which will not necessitate any scrubbing, but a cyanide and acid dips are indispensable. Then, too, it is necessary to have heat enough to decompose the greasy compounds used in polishing and buffing. Where a manufacturer refuses to install a heating equipment sufficient to raise the temperature of the cleaning solution to the required number of degrees, he is only paying many times the cost of a heater in labor and supplies.

Electro cleaning of iron and steel is successfully done where those metals alone are cleaned. Cleaning brass, bronze, copper, zinc, lead, tin or any metal which is slightly dissolved in the cleaning solution, and then using the electro-cleaner for iron and steel is sure to cause trouble, owing to the finer metals being deposited upon the iron if the object is made the cathode, or corroding it if it is made the anode.

Iron and steel may be cleaned successfully by the electro process only as long as other metals are kept out. The hooks for suspending the articles in solution must be made of an insoluble metal, and the work should be made the cathode. The softer metals can not be cleaned electrically and the same solution used any length of time, whether a direct or reverse current is used. Making the work the cathode does not prevent the soft metal entering the solution, as the gases liberated will take up some of the metal.

Where various metals are to be cleaned there should be a tank for iron and steel, one for copper and its alloys, and one for lead, tin, zinc and aluminum; and the temperatures kept at the point which proves the most economical and not two or three, or even 50 deg. below or above that.

Manufacturers should not blame their employees in the plating-room for failure to clean the work, and continually cry out against the cost of coal, gas or oil. More than likely the foreman is trying to hold his fuel bill down to please the cost department, and is displeasing the superintendent by turning out work of an inferior quality

A Platinum Standard

The setting up of a standard and the hall marking of this metal have often been discussed by those immediately concerned, and in view of the increasing use of platinum in the jewelry trades and the fact that it is worth nearly three times as much as an equal weight of pure gold, it has been suggested to the Assay Offices, by a meeting of the trade, the desirability of their establishing a system of hall-marking manufactured platinum articles so as to guard against fraudulent practices by the sale of sundry alloys of platinum in representation of the pure metal.

Absolutely pure platinum is a very soft metal, about as soft as pure silver, and, like that metal, in that condition will prove unsatisfactory for commercial work, and require to be alloyed with a small amount of iridium to make it sufficiently elastic to render it serviceable in the manufacture of commercial wares. The same argument applied to the new standard of silver 0.959, established in the year 1697, in place of the old standard 0.925, when it was soon found by experience that the manufacturers of sil-

ver of the new standard were not so serviceable and durable as those of the old standard, so that for this reason alone, in the year 1720, the old standard had to be resorted to in place of the new standard, commonly called Britannia standard, because it was impressed with the figure of a woman called Britannia. The same results would soon be experienced with platinum articles made from a standard of 0.995 purity. Now, there are two further and very special reasons why a 0.995 standard of purity should not be legally established for hall-marking purposes, apart from the question of its being too soft for articles of utility wherein great tensile strength and toughness, combined with a little hardness, are necessary properties for application in the commercial arts. The present platinum of commerce is not pure, and almost invariably contains from 2 to 5 per cent of iridium, and a portion of this is sometimes added intentionally as a hardener to make it suitable for certain commercial purposes. Firstly, it will be found, after a little more experience has been gained, that it would be necessary to harden pure platinum in somewhat the same way that pure gold and pure silver have to be hardened, and a small portion of iridium left in the platinum will be found the best hardener, particularly as it is closely allied to the platinum and much more expensive than the latter metal—nearly double the price. The 0.995 standard of platinum would not possess that lasting polish which could be imparted to a lower standard containing iridium, say, a 0.950 standard. The former would remain dull, or at most possess a semi-dullness, while the 0.950 standard could have that lasting brightness imparted to it as to give it a more pleasing and lustrous richness. The purer the platinum, the easier it is dented, and the sooner the polish is gone, while on the platinum-iridium alloy the more elastic it is, and the longer the polish stays.

It is also more difficult to get a bright polish on pure platinum on account of its softness, for the polishing materials would lug and adhere more strongly to the surface, and thus the degrees of roughness would be much more difficult to overcome, while with a slightly harder surface they easily glide over the surface without leaving any marks behind.—Abstract from *Jeweler and Metalworker*.

A Successful Brown Finish on Brass

By W. H. Weber

To produce a brown finish on brass goods is hard only in one way, *i.e.*, it tries the patience of the producer, but if the latter will follow the method outlined below, carefully, he can secure a good, lasting brown of any desired shade. The method is one commonly employed. Two solutions are required, a barium sulphide and a copper acetate solution. To make up the former, tie 2 or 3 lb. of commercial barium sulphide (Merck's powdered salt is very good) in a cheesecloth bag and place it in the bottom of a 10-gal. vat, and fill with water. Do not throw in loosely any of the salt, as it is but slightly soluble in water, and is apt to stick to the work on the removal of the latter and cause "brass spots" when the work is subsequently relieved on the scratchbrush. Calcium and strontium sulphides will answer the same purpose, but as they are more expensive than barium sulphide nothing is to be gained by using either of them. The slow solubility of the above sulphides is due to hydrolysis and formation of hydroxides and hydrosulphides as follows:

$$2BaS + 2H_2O = Ba(OH)_2 + Ba(SH)_2$$

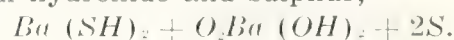
(barium sulphide), (hydroxide), (hydrosulphide).

Barium sulphide may be made by heating in a brass furnace pulverized barium sulphate with charcoal, $BaSO_4 + 4CBaS + 4CO$, using one-fifth as much carbon as barytes.

The second solution is also made up in a 10-gal. vat and contains about 1 oz. copper acetate per gallon of water. The author has gotten best results from neutral copper acetate. Both solutions should be well stirred before using. The barium sulphide solution will be clear, since the loose salt is retained in a bag at the bottom of the vat, but the copper acetate solution will always be cloudy, for this salt is only slightly soluble in water.

In preparing work for dipping it should be sand-blasted to give a good rough surface and cleaned thoroughly in hot caustic, cyanide and water. The articles are then dipped for a few seconds only, in the barium sulphate solution, where they are coated with a thin film of sulphide. This film appears like the stain produced by a hot potash solution when work is left in it too long, and is the result of the union of

the copper of the brass with the sulphur of the barium sulphide, indirectly. This salt reacts with the oxygen of the air to form barium hydroxide and sulphur,



Some of this sulphur reacts with the excess of sulphide, forming polysulphides, but most of it remains to combine with the copper, since barium sulphide is so sparingly soluble in water.

The work is next washed in water and is dipped in the copper acetate solution where more copper unites with the "sulphide film" and darkens it; copper acetate is only slightly ionized, a normal solution of acetic acid being only 0.004 ionized. If the acetate solution is too strong, copper sulphide will form too rapidly and the work will become streaked; if it is too weak, it will require too much time to darken the articles. From this solution the work is again rinsed in water and dipped in the barium sulphide solution again, the whole process being repeated until the desired shade is obtained. Subsequent drying in hot water and lacquering tend to darken the shade of brown but the intermediate operation of scratch-brushing tends to lighten the shade, so that the combined operations are compensating.

The work is now washed in cold water and soap and is dried out in hot water. It is then dipped in benzine and dried in sawdust, compressed air being used to remove the sawdust from the corners. At this stage the articles will appear a dull, dead brown, but after relieving on a dry scratchbrush, they will appear bright and shiny but unpleasant to look at.

Bismarck brown is now mixed with gun cotton lacquer (Ormolu gold will do). The quantity of Bismarck brown is determined by the depth of color desired, and stirred thoroughly. The undissolved particles in suspension are best filtered off through a chemist's suction filter, although they may be almost wholly removed by allowing the sediment to settle and pouring off the clear liquid. The clear, colored lacquer is then sprayed on the work and after drying, we have a quiet, inoffensive, subdued brown.

The production of crude borax materials in the United States in 1914 was 62,400 tons, as compared with 58,051 tons in 1913, according to the *Geological Survey*. All of the crude borax material now used in this country is the mineral colemanite.

*Chemist Waterbury Clock Co.

Extruded Brass Trolley Ears

A trolley ear of extruded brass is being marketed by the Ohio Brass Company, Mansfield, Ohio, an interesting description of which appeared in the July-August issue of the O-B Bulletin, a publication devoted to the interests of the company, and from which the following extract was taken: "Extruded metal is made by pushing or forcing metal through an opening in a die. In order to force a large billet of metal through a small opening, it is necessary to heat it in the same way as it would be heated



Fig. 1—Extruded Trolley Ear

for rolling or forging. The metal for extruding is cast from graphite crucibles into chills forming heavy billets. Careful analysis is made from each cast to make certain that the constituents are properly proportioned to get maximum life under service conditions. Even before casting the prime metals are



Fig. 2—Ordinary Brass Rod Magnified 77 Diameters. Note Coarse Grain

analyzed and are held to very strict specifications. The cast billets are heated in a furnace at about 650 deg. C., and are then placed in the containing cylinder of the extrusion machine. The cylinder containing the billet is brought up against a die holder, and a hydraulic pressure of about sixty tons is applied.

Under this heavy pressure the metal is forced out through the die and is made to assume the special shape required. The die is made from high-grade steel of special composition, and the treatment to which the extruded metal is subjected by the heat and extreme pressure leaves it very solid and homogeneous, and insures great strength and toughness.

"The two micro-photographs show the improvement effected by this treatment. Fig. 2 shows the structure of ordinary brass rod, and Fig. 3 the structure of

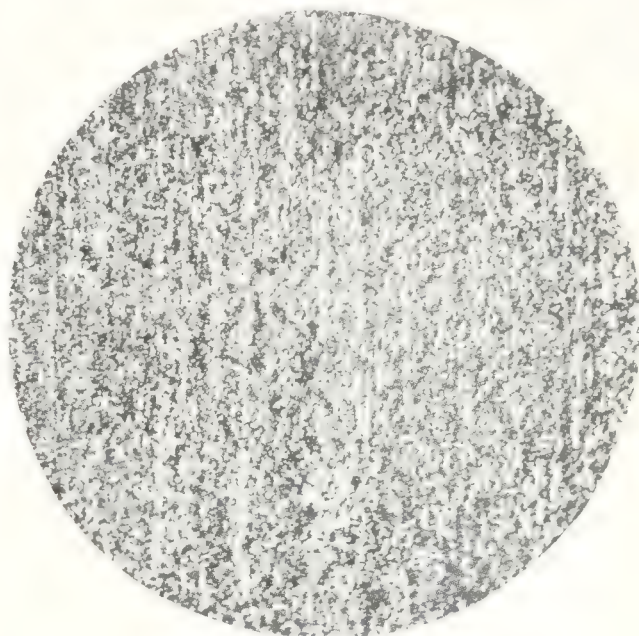


Fig. 3—Extruded Metal Magnified 77 Diameters. Note Close Structure

the extruded metal. Fig. 1 is the finished trolley ear. The section of the extruded metal shows a very close grain even under the magnifying glass, and the section of the rod brass, it will be noted, is much coarser and less homogeneous. The improvement effected by the process of extrusion is therefore quite apparent."

Titanium

One of the most obstinate elements to reduce is titanium, and even now with the aid of aluminum and the electric furnace it cannot be prepared as a metal, but is only obtained at great cost by the reduction of its chloride by sodium. As a metal it resembles iron in appearance, though chemically it is usually classed with the silicon, zirconium, cerium and thorium group, and differs from the other members of this family in that it will not combine with hydrogen.

FROM AMBER TO DYNAMO

PART XI—Electromagnetic Induction

By H. E. Willmore, Jr., B.S.

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One of our fundamental natural laws is the following, known as the law of the conservation of energy: Energy can be transformed, but cannot be created or destroyed. We have seen that when a current flows through a conductor in a magnetic field, the magnetic lines of force on one side of the conductor break and are stretched like so many rubber bands around the other side of the conductor, which is in consequence pushed sidewise with a certain force capable of doing work against an opposing force. In this way electrical energy is transformed into mechanical energy. The human mind is so constructed that we naturally expect things to work both ways; having found that electrical energy can be transformed thus into mechanical energy, we expect that if we were to push the conductor backwards against this force, the mechanical energy so expended would be transformed into electrical energy, which is actually found to be the case.

Lenz's Law

Michael Faraday, in 1831, found that if he thrust a permanent magnet into an open coil of wire whose terminals were connected to a galvanometer (an instrument for measuring small quantities of current), the needle of the galvanometer was deflected momentarily while the magnet was in motion, in other words, while the conductor was cutting lines of force, this showing that current was being generated. The same effect is also produced when a coil through which a current is passing is moved toward or away from another coil, and again when a wire moves across the face of a magnet. If the coil or conductor be moved in a direction parallel to the lines of magnetic force, no current is induced; it is only when it is moved so as to "cut" lines of force that current is generated.

It is found further that the current induced in the coil when thrusting in a magnet is in such a direction that this induced current produces a magnetic field which is opposed to that of the magnet, and it therefore requires work to push in the magnet. Again, in drawing out the magnet, the induced current flows the other way and produces a field which tends to draw the magnet into the coil, and work is therefore required to pull the magnet out again. In view of the law of the conservation of energy as stated above, we should expect something like this. Inasmuch as we obtain electrical energy from the coil while the magnet is in motion, we must expend an exactly equivalent amount of mechanical energy in moving the magnet. The following statement of these conditions is known as Lenz's law: Whenever a current is induced by the relative motion of a magnetic field and a conductor, the direction of the induced current is always such as to set up a magnetic field which opposes the motion. We see, therefore, that the direction of the induced current depends upon the direction in which the conductor cuts the lines of force. We find also that if the poles of the magnet are reversed and it is again thrust into the coil, the needle of the galvanometer is deflected oppositely to what it was when the magnet was first thrust into the coil.

The Dynamo Rule

From the above observations, it is obvious that some fixed relation exists between the direction in which the conductor is cutting lines of force, the direction of the lines of force themselves, and the induced current. The following statement known as the "Dynamo Rule," which is illustrated in Fig. 25-A, gives the relation between these three factors: If the forefinger of the right hand points

in the direction of the magnetic lines, and the thumb points in the direction in which the conductor is cutting these lines, then the middle finger, held at right angles to both thumb and fore-finger, will point in the direction of the induced current.

Dynamo Principles

The electromotive force of the induced current is found by very careful measurement to be dependent merely upon the rate at which the conductor cuts lines of magnetic force. Thus, to increase the electromotive force we may strengthen the magnetic field, use a coil with a greater number of turns, or increase the rapidity with which the conductor moves through the field. The quantity of current that flows is then given by Ohm's law,

$$I = \frac{E}{R},$$

where R is in ohms, E in volts, and I in amperes.

If one takes a large copper knife or copper plate and attempts to bring it down forcibly between the poles of a very powerful electromagnet, he finds that the motion is strongly resisted, and the faster he tries to bring it down, the

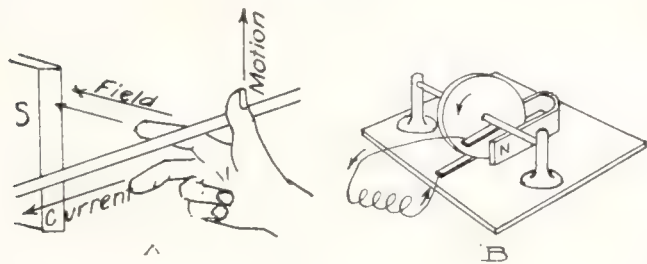


Fig. 25

greater the resistance met with, although copper is not a magnetic substance. This may be explained on the basis of Lenz's law as follows: When the copper plate cuts lines of force, a strong current is induced in it, which circulates about and produces a counter magnetic field that opposes the motion. These circulating currents are known as Foucault or "eddy" currents, and they take quite an important place in the design of electrical machinery, for the energy represented by these currents, having no other means of escape, is changed into heat, and its usefulness lost. For this reason, cores of electromagnets and armatures

of dynamos are laminated; that is, built up of fine wires or thin plates of iron, so as to produce great resistance between their parts and thus effectively reduce the circulation of these currents. If a copper plate be hung on several strings and allowed to swing back and forth edge-on between the poles of an electromagnet, these vibrations will be very quickly "damped" when the current is sent through the magnet. This damping action is often taken advantage of in electrical measuring instruments to bring the needles quickly to rest. The

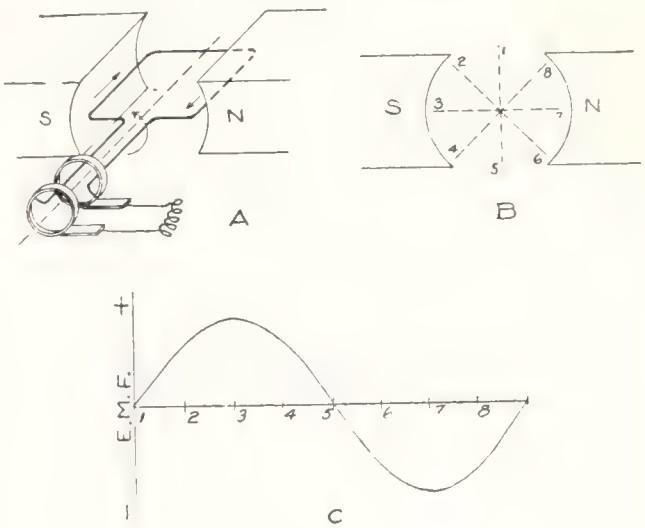


Fig. 26

first method ever used for producing a continuous current by mechanical means, invented by Faraday, was to rotate a copper disk between the poles of a magnet, the plane of the disk being perpendicular to the magnetic field as shown in Fig. 25-B. Brushes bear on the axle and on the circumference of the disk as shown, and the current induced circulates from the circumference to the axle and through the brushes. This disk dynamo, as it is called, is unsuccessful commercially, as the electromotive force generated is too small with any practical sizes of disk and speeds of rotation.

Imagine a loop of wire arranged as in Fig. 26-A, so as to rotate in direction shown by curved arrow between two magnetic poles, about an axis represented by dotted line $a-a$. Applying our dynamo rule, stated above, we find from the direction in which the right hand side of the loop is cutting lines of force, that the current generated is flowing toward us; on the left hand side the

wire is cutting the lines in the opposite direction and the generated current flows away from us. It will be seen, however, that these two currents are flowing in the same direction as far as the conductor is concerned, and thus form a continuous current around the loop. Let Fig. 26-B represent a front view of this arrangement, with the various dotted lines marked 1, 2, 3, etc., representing various positions of the plane of the loop, and the curved arrow again representing the direction of rotation. Fig. 26-C is a curve giving a graphical representation of the relation between these various positions of the loop and the electromotive force of the current induced at each position. Divisions on the horizontal axis are numbered to correspond with the different positions of the plane of the loop of wire, and distances measured parallel to the vertical axis are proportional to e.m.f.'s (electromotive forces) of the currents generated at each position. At position 1-5, known as the "neutral point," the wire is momentarily moving exactly parallel to the lines of force, and no current is generated; the e.m.f. shown on the curve is therefore zero. At 2-6 the wire is cutting lines of force at an angle of 45 deg., and a corresponding e.m.f. is shown. At 3-7 it is cutting the lines at right angles, and the maximum e.m.f. is produced. At 5-1 the wire begins to cut the lines in an opposite direction, and the current therefore flows in the opposite direction, so that the e.m.f. is said to be negative. This negative e.m.f. reaches its maximum value at 7-3, falling again to zero as the wires come back to 1-5, and the cycle starts over again. The effect of this process is to produce a current which surges first in one direction and then in the other, giving us the common alternating current. In practice the magnets used are very powerful electromagnets, with the loop of wire replaced by a coil wound on an iron core so as to provide an easy path for the magnetic flux, this whole arrangement composing a simple alternating current dynamo. It is further complicated by using a number of poles instead of two, and also by winding a number of coils on the armature, so as to give a large number of alternations per second. The ends of

the coils are attached to two insulated copper rings, and brushes bear on these to carry the current away.

Alternating currents are not of much interest to the plater, because electrolytic processes demand a current that flows in one direction only. By the use of a device known as a "commutator" it is possible to transform this alternating current into direct current. Instead of having the two ends of the coil in Fig. 26-A attached to two continuous rings as shown, suppose the two ends to be attached to opposite halves of a single ring that has been split as in Fig. 27-A. Also let the brushes bear on opposite sides of this split ring in such a position that they break contact with one half and make contact with the other at the same instant that the current is reversed in the loop of wire. The result is that as the current is reversed in the wire, it is again reversed in the commutator and always flows in the same direction through the brushes. Figure 27-B is a graphical representation of the resulting current, laid out the same as in Fig. 26-C. Here it is seen that the current is always in the same direction, rising from zero to a maximum and back to zero every half revolution. If we use a four-part commutator with two coils, we have two pulsations superimposed on each other as shown by the dotted lines in Fig. 27-C, the result of which is represented by the heavy line, which will approach nearer and nearer to a straight line, indicating a more steady current as we increase the number of coils in the armature and corresponding divisions of the commutator. In modern direct current generators, the number of coils and corresponding number of sections of the commutator often run up into the hundreds, thus giving a practically constant current.

Motor Principles

A machine of this design can also be used to convert continuous electrical energy into continuous mechanical energy. Referring again to Fig. 26-A, imagine current to be sent through the loop in the direction shown by the arrows. According to the "motor rule," mentioned in Part 10, the left side of the conductor will be pushed upward and the right

side downward until the plane of the loop reaches the neutral position 1-5 in Fig. 26-B. Here the forces act parallel to the plane of the loop, upward at 1 and downward at 5, with the result that the loop comes to a standstill. If the direction of the current in the loop is reversed just as it comes to the neutral point, then the inertia of the moving loop will carry it past this point and a force will again act downward on the upper and right hand side and upward on the other side, so that the loop will continue to revolve so long as the current flowing through it reverses at the neutral points. This is the principle of the electric motor. This reversal of current in the armature might be accomplished by sending alternating current through it, pro-

generators will be taken up in greater detail later on.

Induction Coils and Transformers

So far we have spoken only of current being induced by relative motion of a conductor and a magnet. If we place an electromagnet inside of or close to another coil of wire, and then send current through the electromagnet or primary

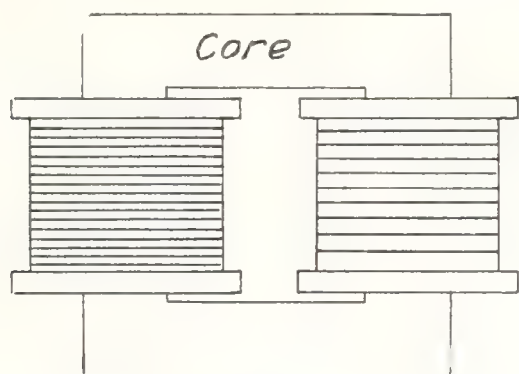


Fig. 28

vided we could so regulate things that the loop would pass the neutral point just as the current reversed. This would be difficult to accomplish, however, because we would have to get the motor up to the correct speed before sending the current through the armature, and after doing so, the speed would have to be kept absolutely constant, otherwise we might have trouble analogous to "back-firing" in gas engines.

If we provide our armature with a commutator as in Fig. 27-A, we can send direct current through the brushes, and if these are adjusted correctly with respect to the neutral points, the commutator will automatically reverse the current in the armature just at the right time. In practice, as with the dynamo, the armature windings consist of very many coils, and the commutators have many sections, in order to give a practically constant turning effort, or "torque." Direct current motors and

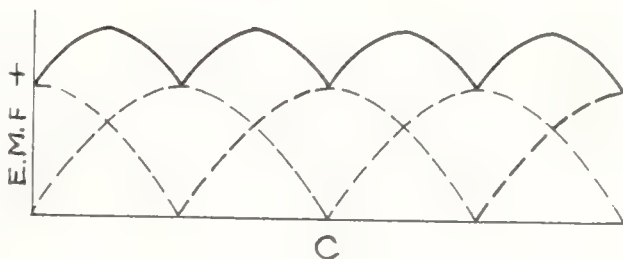
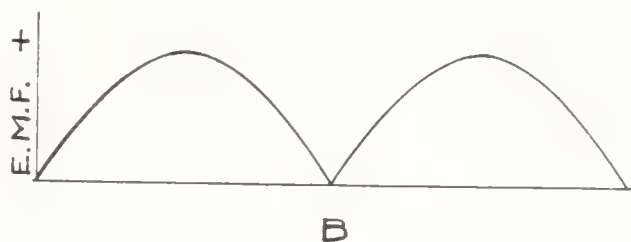
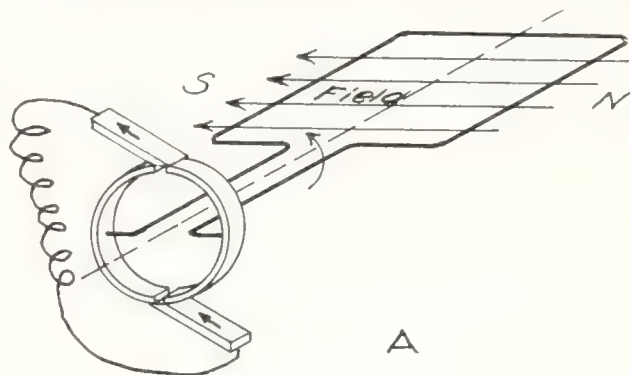


Fig. 27

col, an e.m.f. will be generated in the outside, or secondary coil, both when connecting and when disconnecting the primary coil. This is because as the lines of force spring out on making the circuit and as they collapse again on breaking the circuit they are "cut" by the outside conductors just the same as if the field were held still and the conductor were moving through it. This device constitutes the ordinary "induction coil." As before, the e.m.f. of the induced current depends upon the rate at which the conductor cuts lines of force, or upon the strength of the field which is made and unmade, the number

of turns in the secondary and the rapidity with which the magnetic lines spring out into space and collapse again. If the wire in the primary winding is made very heavy to carry a large current, a soft iron core of high permeability is used, and the secondary is made of very many turns of fine wire, the e.m.f. generated in the secondary may run up into the hundred-thousands of volts.

The current in the primary need not necessarily be made and broken; the same effect is obtained with a pulsating or alternating current. Alternating current transformers are built on this same principle to change the voltage of a given current to either a higher or a lower value as desired. Fig. 28 illustrates a simple type. The core is made of thin sheets of iron with high permeability, to reduce eddy current and "hysteresis" losses, and is made in the form of a ring or rectangle to provide a continuous path for the magnetic flux and reduce leakage of this flux through the air. The "hysteresis" loss just mentioned is the greatest iron loss which occurs in a transformed. In Part II, we saw that when a piece of iron is magnetized the molecules are arranged in a certain way. The arranging of these molecules represents work because they naturally offer resistance to such a change. When the molecules are completely reversed some fifty or sixty times a second, as in transformers and dynamo armatures, the energy used in changing the positions of the molecules, which is wasted in the form of heat, may amount to a quite important percentage of the total power represented by the apparatus. The efficiency of transformers is, however, very high, from 97 to 99 per cent at full load, and they may be obtained to fit any desired specifications.

As an example of the application of transformers, suppose that the only power available for a plating room was on a 220-volt alternating current circuit and the plater had a motor on hand which required 110 volts; he could obtain a "step-down" transformer to make the desired change. For charging storage batteries it is common practice to use the alternating current without the use of a motor-generator, by first sending it through a transformer to get it near

the required voltage and then through a "mercury-arc rectifier," which changes it to direct current. Such an arrangement might be made use of in the plating room to save the cost of a motor-generator installation. As I have never heard of it being used for this purpose, however, I shall not describe the rectifier; the plater can doubtless get any information, if he desires it, from one of the electrical supply houses.

Self-Induction

Upon breaking the current in a circuit containing an electromagnet, a bright spark is usually seen. This is due to what is known as "self-induction." From our previous observations we know that when the current is first caused to flow, lines of magnetic force spring out from the core of the magnet. These lines are cut by the conductor and induce in it an e.m.f. opposite in direction to the e.m.f. of the current already flowing, and since these two oppose each other there is no spark. Upon breaking the current, however, these lines of force collapse and are cut by the conductor in the other direction, producing an e.m.f. in the same direction as the current, which being quite high jumps across the air gap. The tendency of a coil toward self-induction is called the "inductance" of the coil. It is increased by putting iron in the magnetic circuit, which of course increases the number of magnetic lines cutting the conductors. It is due to this self-induction that one is liable to get a more dangerous shock when opening a switch than when simply touching the open circuit. It causes sparking on motor and generator commutators, the remedy for which will be taken up later when discussing commutation. A practical application for it is found in the "spark" coils used in electric gas lighters and for igniting the charge in gas engines.

This is a good way to put the fact. "A fire in this building would be likely to bring much sorrow and suffering, not only to yourself, but to your fellow workers and their families. Think of that when you are tempted to be careless with matches."

Die-Casting of White Alloys

By JOHN C. WORK.

In 1908 the author was called upon to take charge of a die-casting business for the manufacture of small parts of various machines and appliances which ordinarily required a good deal of machine work. The process by which these parts were to be made was supposedly a secret one, which had been brought from France by a Frenchman who had worked for several years in a plant engaged in similar work.

Abroad, according to the best information obtainable, this plant was turning out not only small articles made of white metal, but had even succeeded in casting aluminum crank cases for automobile engines which were so perfect that they could be fitted together without any machine work whatever. Although this state of perfection was never realized in our work, many small articles were successfully cast in white metal, accurate to 0.002 in. While this is being done at the present time by several concerns, the process calls for the application of pressure to the molten metal in order to force it to fill the molds completely. The French process, with which the author was connected, did not require any pressure other than that afforded by approximately a 6-in. riser in the die itself.

The chief reason for the lack of financial success of our company was the inability of the French workmen to realize the value of time in American business methods, coupled with lack of capital to install the apparatus which experiments led the management to believe necessary.

While the actual composition of the alloy used in France was supposed to be a profound secret, known only to the one who brought it to this country, the author found that any of the numerous so-called "white metal" alloys, such as are given in Kent or similar handbooks, may be cast satisfactorily to the above mentioned accuracy, with a very small percentage of failures. The intricacy of the casting appears to be limited chiefly by the skill required in the manufacture of the die.

The die should be made from highest grade gray cast iron. The workmanship must be of the very best quality, and all the parts going to make up the complete die must be capable of being taken apart and assembled with a minimum amount of labor. They must have numerous vents to

permit the escape of gas from the cooling metal.

A good deal of the success in making castings seemed to lie in having the molten metal at the correct temperature; if too hot, it did not seem willing to take the exact form of the mold, and if too cold it would not flow with sufficient freedom to fill the intricacies. If poured at the right temperature, there was no trouble in casting the thread on bolts from $\frac{1}{8}$ -in. diameter up.

Before pouring the metal, the molds were heated, and then plunged into a tub containing water and whitening, which was kept in a state of suspension by stirring. This dipping was followed by another heating of the molds. When the molds had reached a proper temperature, which was entirely a matter of judgment on the part of the man handling them (testing the temperature as a woman tests the heat of a flat-iron), the metal was poured. The small castings, which were most successful, cooled enough to be taken from the mold in a very few minutes. This process was repeated, dipping the molds after every three or four casts.

One of the chief fields for this class of work was originally thought to be in the carbureter line. While we were quite successful so far as turning out the parts and fitting them was concerned, no one realized, or knew from experience with the metal used, the effect of gasoline upon it. While in the liquid state, gasoline apparently had little or no effect, but when vaporized, or when just vaporizing at the spray plug, it acted on the metal with the formation of a white deposit. This deposit was never analyzed, but much resembled zinc oxide in appearance. This deposit rapidly caused the suspension of ignition and the entire carbureter had to be taken down and cleaned. In the small plant, and using hand molds, we were never able to cast an alloy running high enough in aluminum to make any material difference as to the effect of gasoline vapor.

While the author does not believe that aluminum in anywhere near a pure state can be cast in dies without using pressure, he believes that with proper ovens in which to heat the dies, and with the use of pressure to force it into them just at the moment of solidification, die castings can be made which will far surpass in accuracy any aluminum castings yet produced.

A few attempts were made to cast brass in dies, but they were not satisfactory. While occasionally a perfect thread would be obtained, there was apparently too much gas in the metal. This trouble was lessened but not wholly overcome, by increasing the number and size of the vents in the die. After a considerable amount of experiment had proved that the die casting process, as carried on, was not particularly satisfactory, chiefly owing to the expense of making dies for small orders, this end of the business was abandoned, and the shop was converted into a brass foundry.—*The School of Mines Quarterly*.

Oxy-Acetylene Welding of Copper Alloys

In an interesting article on the subject of fluxes for oxy-acetylene welding, in the June issue of *Machinery*, S. W. Miller makes the following observations regarding copper and its alloys:

There is no necessity for using a flux for welding copper, if the surfaces are clean and if the proper welding rod is used. Ordinary copper is quite free from impurities, because traces of such impurities make it impossible to use the copper. This metal, however, has several peculiar properties. When melted it has a strong affinity for gases, such as hydrogen and carbon monoxide. Oxygen is also absorbed by the melted metal, producing copper oxide, which forms a true alloy with the copper, making it brittle and worthless. When the metal solidifies these occluded gases are given out, leaving the metal a mass of blow-holes. It is, therefore, necessary to provide something which has a greater affinity for oxygen than the copper. This is done by the use of phosphorus, which, instead of being used as a flux, is incorporated in the welding rod. Only a small percentage of phosphorus is required, as none should remain in the weld after it is made, although small traces of phosphorus in copper have no bad effect on its physical properties. It is evident that the production of such welding rods or wire is a matter which should be left in the hands of competent manufacturers. This special copper-welding material can, of course, also be obtained from apparatus manufacturers.

The alloys of copper include the various brasses and bronzes, which are exceedingly numerous and of a great variety of compositions. A brass is an alloy of copper and

zinc. A bronze is an alloy of copper and tin. These alloys may have added to them lead, antimony, iron, manganese, nickel, etc., in smaller percentages than the main constituents. Inasmuch as it is impracticable in ordinary repair work to determine the percentage of the elements in copper alloys, it is manifestly impossible to make a truly autogenous weld, i. e., one containing the same elements as the piece to be welded. Of course, where the process is used in manufacturing and the composition of the alloy is known, some experimenting will probably enable one to determine the most suitable mixture to use for welding rods; but in repair work it is necessary to find some one or two alloys which will apply to all of the metals that are likely to be met with. This is well taken care of by the manufacturers of welding apparatus and welding material, and suitable rods for general brass and bronze welding can best be obtained from them. The writer has found the best all-around welding material to be manganese bronze, although he has also used Tobin bronze with good results. The so-called manganese bronze is really a manganese brass, because the two principal ingredients are copper and zinc, the percentage of tin being quite small. Rolled manganese bronze rod or wire is quite fluid and makes a very good weld. Tobin bronze is somewhat more fluid, and while in many cases it works well, yet if the melting point of the piece that is being welded is high, due to the presence of a considerable percentage of copper, it may be difficult to get it to melt at the same time as the welding rod; manganese bronze not melting at quite so low a temperature is, therefore, found more satisfactory as a general rule. Tobin bronze is really a Tobin brass, as it consists mostly of copper and zinc.

It should be understood that the percentage of the various elements in both manganese bronze and Tobin bronze may vary considerably, so that they are not alloys of constant composition, the difference depending on the ideas of the manufacturers; but both contain some iron, which appears to give greatly increased strength and makes the essential difference between the properties of these metals and ordinary brass. As all brasses contain zinc, which readily volatilizes under the heat of the torch, the advisability of having a considerable percentage of zinc in the welding rod

is apparent. Theoretically, the fluxes for a copper alloy should depend on the composition of the alloy, but while there are some objections to it the writer finds that for all practical purposes ordinary borax gives very good results. To prepare the borax for use, it should be melted and then allowed to cool, after which it is powdered, because in its original condition the borax does not lie quietly in the weld, but foams up and a good deal of it is wasted. It is the writer's experience that greater success is obtained by using a satisfactory welding rod for copper alloys than by varying the fluxes; and it should not be forgotten that when the composition of the piece being welded is unknown, the use of one flux may be satisfactory while another one is not. Borax seems to be the best all-around substitute. In welding brasses and bronzes care should be taken not to heat the piece too hot. If carefully observed, it will be noticed that at a certain temperature the prepared surfaces will show little globules rising from them. This is the temperature at which the metal from the welding rod should be added. It will be found that if this is done a satisfactory weld will be made, provided the surfaces are clean and a small amount of borax is used as a flux.

Locating Machines in Brass Finishing Plants

By EFFICIENCY

One of the leading factors in production of brass goods with safety from accidents, is the location and spacing of machines with reference to the output of those in the immediate vicinity.

I have observed the apparently crowded conditions of polishing and machining departments in brass plants, where want of space and the addition of extra tools, during the growth of the concern, demanded those conditions. Too often this is done with a view of economy, but very often this same apparent saving has been a handicap in getting the full production of the machines, and at times has been the cause of accidents.

To produce satisfactory results from the operation of almost any machine, sufficient space must be left about it on the floor for the convenience of the operator, also for the product before and after the machining or polishing and buffing operations. If the space is not available, the

freedom of action of the operator is hindered and, therefore, the output is restricted. Where two or more machines are crowded together, it prevents operators giving proper attention to their work.

If the men are on a day rate system, and the movements of one in placing or removing work interfere with the other, one of the operators in many cases must remain idle while the other performs his necessary task. If the men are working on a piece work or premium system, the second man will often continue his work at the risk of injury to some part of his person.

I have seen an operator of a screw machine or turret lathe working at high speed, which was directly in line with another operator. Suddenly, without any warning, the casting flies out of the chuck, or a tool breaks off without any warning, and the piece is projected at the man working opposite, fortunately missing him by a few inches.

Sometimes, owing to lack of sufficient space in the aisles between machines, when work must be transferred from place to place, a slight misstep or slip may cause a person to stumble, forcing him to put out his hand to protect himself from falling. This effort may cause him to come in contact with rapidly revolving machines or belts, and the result is probably an accident to himself or some one working close at hand.

Another source of trouble may result from the placing of machines, such as screw machines and hollow spindle lathes, in positions where the projecting parts will cross an aisle or project in close proximity to a bench where other workmen must pass, and often before a warning can be given the clothes or flesh is badly torn. A pile of castings or other material will sometimes be placed temporarily in a location where a workman is accustomed to perform his duties, and is often the cause of injury. Often when an accident has occurred, the injured person must bear the blame, when in reality the local conditions are responsible. The cause of many an injury and short life to a machine can be oftentimes traced to the location of said machine too close to the flying articles from an adjacent grinding or polishing machine.

The dust from the continual grinding penetrates to all parts of the machine and the movable parts receive a large part of

this destroying agent. The destruction is so gradual that when the fault is at last noticed, the injury in many cases is beyond repair, or when repaired it is not the same machine again.

There has been a universal cry of "Safety First" as a slogan in manufacturing plants since the Workmen's Compensation Act went into effect in many states, and since it has been advocated so strongly, any improvement in these conditions would be a step in the right direction of advanced economy and increased production, as well as the bettering of the welfare of the working conditions and moral responsibilities of employer and employee.

Phosphorus in Aluminum Bronze

In an article dealing with the effects of phosphorus on aluminum bronze, in *Chemical Physics and Electro Chemistry*, A. A. Reade states that alloys containing 10 per cent aluminum will only stand 0.2 per cent phosphorus, as more than this quantity causes the metal to give off phosphine when it is being filed or turned. The effect of very small quantities of phosphorus on annealed samples of aluminum bronze is to raise the yield point a little and increase the elongation and reduction of area very considerably, while the maximum stress remains the same.

The 5 per cent aluminum bronze will take more phosphorus than the 10 per cent alloy, as up to 1 per cent of phosphorus can be incorporated, and the worked metal will show no trace of phosphine. On annealed samples of the 5 per cent alloy the effect of phosphorus is to increase slightly the yield point and maximum stress, the reduction of area being lowered as the content of phosphorus is raised. In the case of chill castings with increase of phosphorus the yield point rises continuously and the ultimate stress attains a maximum at 0.52 per cent phosphorus, but the elongation and reduction of area fall rapidly.

Results of alternating stress tests show the deleterious effects produced by annealing the 10 per cent aluminum bronze. Phosphorus does not appear to affect the hardness of annealed bars in small increasing amounts, but with cold drawn bars the hardness is slightly raised. With 5 per cent aluminum, small amounts of phosphorus do not alter the hardness of annealed bars, but in chill castings a considerable increase in

hardness is obtained when 0.25 per cent phosphorus is passed. Tests for electrical conductivity show that the conductivity of the 5 per cent alloy is only slightly greater than that of the 10 per cent alloy; phosphorus diminishes the conductivity in both cases, the diminution being more marked in the case of the 5 per cent alloy, being with the same amounts of phosphorus, twice as great as in the 10 per cent alloy. Phosphorus is found to lower the melting point of both alloys.

A number of corrosion tests were also made; the results show that pure fresh water has an exceedingly small action on these bronzes, while in the case of sea water the effect of small quantities of phosphorus is to reduce the loss of weight due to corrosion. It was found that the solubility of phosphorus in copper is increased by phosphorus.

Aluminum on Iron

The following account is an interesting newspaper story found in the *Kansas City Post*. As a substitute for zinc for plating, a newspaper reporter, who is a chemist as a side line, has found the way to plate aluminum on iron. This is the story:

This man is Tad Powell. He started work on the problem at the request of a local manufacturer. He succeeded a few days ago, where chemists have failed for twenty years. They had tried to plate other metals with aluminum, but had not been successful in a practical sense.

The main stumbling block to the success of the others, he utilized and harnessed into an ally. This "stumbling block" was the powerful affinity of aluminum for oxygen. Instead of blocking him, it was made to help him and, in fact, is the very secret of his process.

The discovering is likely to affect the kitchen ware industry. It will find a broader field in the plating of cooking utensils.

Tests have shown that moist acetylene, as generated, attacked zinc, lead, brass and nickel to a slight extent; iron was affected at about six to seven times the rate; phosphor bronze about twice as much as iron; but copper suffered more than any other metal tested. Copper was quickly changed into a soft, porous black mass. Tin, aluminum, bronze, German silver, and solder were practically unaffected.

Waste: The Plater's Savings Bank

There has been and will be countless homilies on the use of waste. Occasionally, by the use of new methods applied with originality, the kaleidoscope of waste presents a new picture, owing to the way the various elements reform themselves.

Just now interested attention is directed to the use of the new welding process as applied to used up and scrapped nickel anodes, converting them into serviceable units once again—renewing their youth, so to speak, much to the advantages of the bank account of the plater.

The idea, we believe, was first evolved by a company in the Middle West whose large plating department created a larger scrap pile of these partly exhausted anodes. Their anodes were of nickel, carbon and iron, weighing about 30 lb. By welding up these old pieces by use of oxy-acetylene apparatus a very considerable loss in discarded material soon waxed into a substantial gain. The company has been able to convert its scrap nickel into what are practically new anodes, at a cost for gas and labor so slight as to be negligible.

The operation is described as follows: As the anodes are eaten away by the solution they are turned over to an oxy-acetylene welder who tacks on scraps of old anodes by welding to increase the surface. One, two, three and sometimes four pieces of scrap are welded on, depending on the size and weight desired.

The welding flame is also employed to remove the brass hooks, which are used to support the anodes while in solution. Under the intense heat of the oxy-acetylene flame, the solder melts away rapidly, leaving a pure nickel bar which is later welded up.

Thus, by the addition of from, say, 5 to 15 lb. or more of scrap nickel a brand new anode is manufactured at trifling cost and every bit of scrap is utilized without the loss of a single pound of metal.

No flux is employed, as this has been found to be unnecessary. The pieces of scrap are simply fused together, using another piece of nickel as a filling rod. The welding process is a benefit in ob-

taining perfect fusion which is essential, as all joints must have electrical conductivity equal to that of new anodes.

No skill or experience in the art of oxy-acetylene welding is required to weld up scrap nickel anodes. Any workman with average intelligence can do the work without previous knowledge of the process. The apparatus required to do the work is inexpensive.



The illustration clearly shows the results of the operation of recovery.

◆
“Rolled Gold” as the term best fitted to describe articles composed of one or two plates of solid gold, with a metal filling between, has received the official sanction of the National Association of Goldsmiths of Great Britain. The subject was brought up at the twenty-first annual conference in London, when, after a long discussion, it was decided unanimously that “gold rolled” was not the term most acceptable to the trade.

QUESTIONS AND ANSWERS

All communications under this head should be addressed to the "Questions and Answers Editor"

Platinum Plating

QUESTION No. 111.—Have you any information concerning platinum plating?

ANSWER.—All the improved processes have been patented, so do not know what to recommend. Why not get in touch with firms doing such work?

Brown Dip

QUESTION No. 127.—Let me know of a good formula for brown dip on copper, known as French bronze; must be used cold.

ANSWER.—A few drops of ammonium hydrosulphide solution per gallon of water gives very pleasing brown bronzes on copper work. A weak liver of sulphur solution may be used, although the bronzes obtained are apt to be more or less iridescent.

Annealing Brass and Copper Wires

QUESTION No. 128.—Would you kindly advise how to obtain a bright anneal on brass and copper wires, in order to do away with cleaning with acids?

ANSWER.—A special furnace, known as the Bates and Peard Annealing Furnace, is largely used for bright annealing. In the operation of this furnace the articles to be annealed are automatically conveyed through a water seal into a muffle furnace, and after being annealed are passed from the muffle through a second water seal to prevent oxidation. The articles emerge from the furnace in a soft and bright condition, and pickling is thus obviated.

The Nickel Abstraction Difficult

QUESTION No. 133.—We have on hand a large quantity of nickel steel and would like to know how we can obtain the nickel therefrom.

ANSWER.—We fear that you will be unable to effect a separation of the

nickel and iron, and about the best way in which the alloy could be utilized would be in the form of an alloy approximating in composition to monel metal.

Rust on Enamel

QUESTION No. 139.—In the manufacture of steel furniture we must, at times, do some soldering, and in cleansing the iron with acid we have recently experienced trouble with rust marks after article is enameled. It seems that the rust comes through underneath, but appears on the surface of the enamel, and in some instances it oozes through the joints in small liquid bubbles. All of our furniture is finished with enamel, baked on with 170 deg. Can you inform us how to overcome the trouble?

ANSWER.—Would suggest that you either try a flux like rosin, or if you prefer to use an acid flux, that you neutralize all acid after soldering with some alkali, and then remove the alkali by thoroughly washing with hot water and drying well.

For a Green Dip

QUESTION No. 148.—Please instruct me how to make a green bronze dip, or a solution that will turn copper-plated work green.

ANSWER.—The green dip is made as follows:

Water	1 gal.
Acetic acid	8 oz.
Sulphate of copper.....	4 oz.
Common salt	2 oz.

Use as a dip, and hang up in a damp place if possible. If a quick-acting dip is required, muriatic acid should be used instead of the acetic acid.

Removing Grease, Dipping, Etc.

QUESTION No. 149.—We are trying to do our own nickel plating. We do not copper plate the parts previous to nickel

plating. We have experienced difficulties in removing the grease from these parts. They are not dipped before plating, being partly buffed. We are using strong potash, hot water and cyanide solution for cleansing. Kindly suggest some rapid grease solvent or some quick way of cleansing. Would a copper bath remove the grease? Our brass dip, made up according to Van Horne's formula, seems to be rather strong, and the dipped brass articles are much streaked. Would muriatic acid instead of the addition of salt give better results?

ANSWER.—Heavy mineral oil is best removed by dipping in gasoline. If gasoline cannot be used, 1 lb. Mineral Cleaner per gallon boiling water will be found quite as effective. The use of a copper bath would only complicate matters, as the grease would very soon spoil it. All brass work should be dipped before being buffed. The following is the regular dip:

Oil vitriol 2 parts
Nitric acid 3 parts
Muriatic acid 4 oz.

(per gallon of dip)

All black oxide must be pickled off in 6 parts of water to 1 of oil of vitriol pickle before being bright dipped. After being acid dipped, the articles must be dipped in a weak cyanide dip, then dipped in a soap and water wash, then dipped in hot water and dried.

Rust Proof Black

QUESTION No. 151.—We want to produce a blue or black finish on polished steel. Sample to be finished mailed.

ANSWER.—The process that is being used quite extensively for a rustproof black is to give the steel pieces a light copper plate, then heat in an open muffle until the copper is oxidized. The heat required allows the copper to permeate the steel, thereby making the article comparatively rustproof.

Verde Antique Finish

QUESTION No. 153.—How can we get a good verde green finish?

ANSWER.—The finest verde antique finish is obtained by the burning-in process. A solution composed of 12 oz. of sulphate of copper per gallon is sprayed over the articles. After being sprayed

with the solution they are held in an intensely hot gas blast for a few seconds, or until the sulphate solution is converted into a beautiful verde. Relieve and wax as usual. For other green dip see Question No. 148.

To Clean Aluminum Castings

QUESTION No. 119.—How will we clean oil and dirt covered aluminum castings to look same as when they come out of the sand? They are not to be plated.

ANSWER.—Clean them best with gasoline.

Not Enough Cyanide

QUESTION No. 129.—We have been using a hot copper solution which was made up originally with lye for cleaning purposes, but which has been used more recently for plating only. We read with interest your article in July number on this process and decided to try Rochelle salts to dissolve the oxide which had always been present on the anodes during plating. We added but 1 lb. to 100 gal. of solution, which immediately commenced to deposit black streaks on the work, although the copper deposit was good. We ask if you can give us information as to how we may overcome this defect without making a new solution?

ANSWER.—The trouble may be due to some impurity in the salt or to insufficient cyanide in the bath. The latter is suspected, and would suggest that several successive additions of cyanide be made, which may cure the cause. The amount of Rochelle salts stated as used is not sufficient for the purpose intended, unless the bath is weak in metal. It should be added until anode corrosion is satisfactory, pound at a time, with enough cyanide to give a clean, bright deposit.

Black Nickeling and Oxidizing

QUESTION No. 134.—What is the process for black nickeling and black oxidizing? We want to apply to brass fasteners (samples sent). Which of the two would hold better?

ANSWER.—Black nickel is the best finish for these articles. The formula follows:

Double nickel sulphate..... 8 oz.

Ammonium sulphocyanate .. 2 oz.
 Zinc sulphate 1 oz.
 Water 1 gal.

Blacken Iron Without Salts or Lacquer

QUESTION No. 132.—Is there a solution to blacken iron pieces to prevent rust, and avoid using nickel or any kind of black lacquer?

ANSWER.—The only processes are patented, and we cannot give exact details.

Three Simple Questions

QUESTION No. 140.—(1) How much soda do platers put in a brass or copper solution, and why? (2) How is a black nickel solution made? (3) What is the right way to take care of a nickel solution?

ANSWER.—(1) Soda serves for the preparation of metallic carbonates and for freeing objects from grease. The impure soda is most often used for latter purpose. (2) Black nickel formula:

Water 1 gal.
 Double nickel sul. 8 oz.
 Ammonium sulphocyanate 2 oz.
 Zinc sulphate 1 oz.

(3) To care for a nickel solution it is best to make a new one when the old gives poor results.

Tobin Bronze

QUESTION No. 145.—Kindly inform me of a good mixture for a Tobin bronze, also a manganese bronze.

ANSWER.—Use the following formula in making Tobin bronze:

Copper 58.00 per cent
 Zinc 40.00 per cent
 Tin 1.50 per cent
 Iron 50 per cent

Introduce the iron as tin plate, stirring into molten copper.

A manganese bronze formula follows:

Copper 56 lb.
 Zinc 42 lb.
 Iron 1½ lb.
 Tin 1 lb.
 Aluminum ½ lb.
 80 per cent ferromanganese ½ lb.

Pour into ingots and remelt for castings.

Making Rough Castings Smooth

QUESTION No. 146.—I am forwarding for your inspection a piece of brass cut from a casting which we have made, and which you will note is very rough of surface. We would like to know what causes this difficulty; the castings are very thin and consequently the metal has to be poured very hot. The mold is faced with a mixture of one-third new sand and two-thirds old molding sand. We have also tried all old sand with the same results. The mold is rammed very hard. Is the sand too weak? If so how may this condition be remedied? Or is it the metal which is to blame? The alloy used follows: Copper, 85 per cent; lead, 5 per cent; tin, 5 per cent; zinc, 5 per cent.

ANSWER.—The difficulty is caused by the hot metal cutting away the sand surface of the mold in its path, and the roughness will probably be more noticeable near the gates. Use a facing composed of half new and half old sands, to which is added one part flour to twenty sand, and mix to the proper molding consistency with weak molasses water. It will probably be found advisable to torch the mold after it is finished and floured just previous to pouring, but before resorting to this precaution, it might be well to pour one in green sand to determine whether it is necessary to go to the extra trouble of skin-drying. The molds should not be rammed too hard, as this may be the cause of the trouble. The use of a thin vent wire will help matters considerably. The alloy is satisfactory.

Mixture for White Metal

QUESTION No. 150.—Kindly give me the cheapest mixture that you know of for a white metal.

ANSWER.—The following alloys are recommended:

(1) Lead 87 per cent
 Antimony 13 per cent
 (2) Zinc 90 per cent
 Copper 6 per cent
 Aluminum 3 per cent
 Tin 1 per cent
 (3) Lead 80 per cent
 Tin 10 per cent
 Antimony 10 per cent

Formula for Antimony, Tin and Lead

QUESTION No. 152.—Please give us a formula for solder that calls for antimony in connection with tin and lead.

ANSWER.—The following alloy can be recommended:

Tin	46 per cent
Antimony	2 per cent
Lead	52 per cent

Extracting Oil from Brass Shavings

QUESTION No. 154.—Will you please advise us how best to economically extract oil from the brass shavings and clippings accumulated after operations in automatic lathes, where the waste is deluged in oil?

ANSWER.—If the object sought is to extract the oil, filter it and use it over again. We believe that a centrifugal separator would meet the situation, and we suggest that you communicate with the manufacturers of such machines and place your problem before them. The oil can be extracted by washing the chips with some hydrocarbon oil, such as gasoline or kerosene, if the object is merely to obtain clean chips.

To Remove Soldering Coppers from the Handles

QUESTION No. 155.—We have on hand a quantity of discarded soldering coppers and would like to be informed as to the best way of removing them from the iron handle. What degree of heat would be required for melting the copper, and how would we have to go about the work to get the result desired?

ANSWER.—The simplest way would be to cut it off in a power shears. The little splinters of iron could be removed from the cut copper with a magnet, or could probably be picked out without difficulty. If this means of removing the iron cannot be adopted and melting must be resorted to, this could be accomplished by first melting a bath of copper, and when very hot, charging the irons several at a time and leaving them in the bath until the copper either melts or becomes so heated that it crumbles off the iron. The irons may then be removed with tongs, and the bath allowed to regain its temperature. The furnace will require careful attention to prevent

the iron melting, as well as the copper tips. With the best of care some iron will get into the copper, and will be incorporated therewith to its detriment, as the iron will oxidize and scale off into the copper, therefore the metal will be difficult to use in a satisfactory manner. Another method would be to charge a number of the coppers into a crucible, allow them to become a cherry red but not melt, then remove them and pound off the copper. The proper temperature can be easily ascertained by a few trials, as if it is too low the copper will not crumble but will be tough and plastic.

Imitation of Platinum

QUESTION No. 157.—Am particularly interested in a cheap method of blacking a figure in hollow ware without blacking the entire surface (French gray). One way, of course, of doing this is with platinum. This is very expensive, and I have a recollection of having read some article published by you on this very subject.

ANSWER.—A good imitation of platinum is made as follows: Dissolve iron filings in C. P. muriatic acid until the acid is saturated. Pour off the clear acid and add exactly the same amount of nitric acid. The acids must be mixed in a very large dish or jar, as a very violent boiling takes place a few minutes after they unite. As soon as the mixture cools off it can be used as a dip or applied with a brush.

Casting Silver in Iron Molds

QUESTION No. 141.—We have had some difficulty in casting silver in iron molds, as the castings come spilly and more or less porous. We have used both thick and thin cast iron molds and also sheet iron molds with practically the same results. We use pure sterling silver scrap that has simply been cut in pieces, and melt it in a small crucible with charcoal for a cover, and add some rosin for a flux when the metal is hot. The iron molds are coated with graphite. We would appreciate any information you could tender us.

ANSWER.—The silver was melted in the proper manner, that is, under a cover of charcoal, but no mention is made of

the use of a deoxidizer, and this is probably the reason why difficulty was experienced in casting the metal. The deoxidizer generally used in the case of silver is cadmium, which is used in any proportion up to 5 per cent with excellent results. Silver dissolves cadmium up to 20 per cent, forming an alloy consisting of a homogeneous solid solution, which is more malleable and ductile than silver alone and is also whiter than silver. We suggest that cadmium be tried in connection with these castings, using at first 2 per cent, and if not sufficient, increasing to 5 per cent.



Two Self-Explanatory Letters

Alfred Levy of Paris has written to O. P. Watts concerning his article on "Cleaning and Plating in the Same Solution," that "the only fundamental patent in this direction is my patent, No. 923,864, June 8, 1909, a patent which has been granted me outside the United States in all countries of preliminary examination, and, since this invention has met with great success all over Europe, there have naturally been certain infringements which I have successfully sued. In drawing your attention to this fact, I am convinced that you are entirely bona fide in the matter, nevertheless by recommending electroplaters to make such solutions you are certainly, without wanting it, inciting third parties to infringe on my patent and in this way expose them to consequences which would go beyond the intention of the article, which, I am convinced of, has been written only in the interest of science."

Mr. Watts appreciates the position of Mr. Levy, and we think his letter to the editor of BRASS WORLD clears up the subject in a way that leaves the good faith of all parties in interest unblemished. Mr. Watts writes:

"Since the publication of my article in your July issue I have received from Alfred Levy the letter which I wish you would publish for the benefit of such of your readers as may have read my article. In writing the article it was not my intention to incite the plating fraternity to violate the patents of anyone. Although I had read a patent by

Mr. Levy concerning the use of *ferrocyanides* instead of *cyanides* in electric cleaners, I had not seen the particular patent referred to in his letter."



Cobalt Plating

The experiments in baths of cobalt carried on in the laboratories of Queen's University, Canada, under supervision of Dr. H. T. Kolmus have resulted in fine practical results. We give, herewith, a description of one of these baths used for ordinary plating purposes, or the plating of non-conducting surfaces.

The bath consists of a nearly saturated solution of Cobalt ammonium sulphate, $\text{SoSO}_4 (\text{NH}_4)_2 \text{SO}_4, 6 \text{H}_2\text{O}$. Two pounds of the crystals are dissolved in each gallon of solution required. The specific gravity of 15 deg. C. being 1.053. The bath thus prepared requires no additions to maintain neutrality, and may be immediately employed for coating brass or copper cathodes of small area. Aging treatment is necessary to bring the bath up to its maximum efficiency and permit the coating of steel or iron cathodes whose areas approximate the anode area.

The aging treatment required is of short duration as compared with nickel. The bath is operated neutral and produces firm, smooth, white, extremely hard, adherent plates which color very easily to high luster. An alkaline condition of the bath produces grayish plates which pit, peel and curl. When acid, the bath yields firm, smooth deposits which are quite adherent, but dark and freakish. The anodes remain free from slime and disintegrate very readily, while creeping salts are absent, the bath remaining clean and attractive in every respect. When properly aged and operated neutral with proper current density, the bath throws very satisfactorily into deep recesses and enables the treatment of very irregular pieces to be conducted without unusual care.

Current densities, ranging from 20 amp. per square foot to 45 amp. per square foot, are recommended as being productive of best results, with bath at room temperature. Warm solutions will permit of much higher current densities; agitated cathodes also facilitate greater speed in plating.

Scrap Copper Recovery in 1914

Secondary metals, states J. P. Dunlop of the U. S. Geological Survey in a recently issued bulletin, are those recovered from scrap metal, sweepings, skimmings, drosses, etc., and are so called to distinguish them from the metals derived from ore, which are termed "primary metals." The recovery of these secondary metals in 1914 aggregated about 287,000 short tons, and comprised lead, zinc, copper, tin, antimony, and aluminum made from scrap metal, drosses, etc. As these secondary metals sell at prices only slightly lower than new metal, and displace an equivalent quantity of primary metals, they must be considered in any estimate of stocks available for consumption in any year. For a few purposes requiring especial purity of material it is necessary to employ primary or virgin pig metal, but as a general rule secondary metals can be used in whole or in part.

In fact most foundries in order to compete for business successfully, must and do use secondary material at least in part, and hence they purchase scrap metal and remelt it with primary pig metal or with composition ingot. The secondary smelters by handling large quantities of all kinds of scrap are able so to classify their material as to produce continuously alloy metals of uniform composition suitable for use in work of different classes.

The total quantity of secondary copper recovered in 1914, on the assumption that the brass remelted had an average copper content of 70 per cent, was 127,882 tons, of which 15,964 tons (about 2700 tons less than in 1913) was recovered by plants refining primary metals, and the remainder by plants treating only secondary metals.

The copper produced by smelters of the latter class includes 36,658 tons of pig copper, 5934 tons of copper in alloys other than brass, and 69,326 tons of copper in remelted brass.

These figures indicate a decrease for 1914 of about 2700 tons of pig copper and 50 tons of copper in brass and a decrease of about 5600 tons in alloys other than brass.

At least 40,000 tons was recovered from clean scrap made in course of manufacture of copper and brass ware, so that only about 77,800 tons was obtained from ashes, cinders and scrap, or from material that had actually been used and discarded. The value of the copper, both as metal and in

alloys, is computed at the average yearly price quoted for casting copper by the American metal market.

According to the Bureau of Foreign and Domestic Commerce, the exports of scrap brass, fit only for remanufacture, for the calendar year 1914 were 10,420 tons, and the imports were 2565 tons.

Many railways sell or turn in the larger portion of their brass and copper scrap and other metal waste to dealers in part payment for new material, but the reports received show that the railways utilized in their own shops and foundries over 12,069 tons of brass, in addition to 700 tons of copper and 1362 tons of copper in alloys other than brass.

The production of copper from secondary sources in 1914 was equal to about 19.7 per cent of the refinery output of primary copper in the United States from all sources, or about 22.2 per cent of the primary copper smelted from domestic ore.

The secondary lead recovered in 1914 amounted to 61,062 tons or about 11,800 tons less than in 1913. The main sources of secondary pig lead are old pipe, lead cable, battery lead, and lead lining of acid tanks. Regular smelters report the recovery of 11,108 tons of lead from scrap lead and scrap antimonial lead.

—♦—
"If we—any of us in the business—had only had sufficient vision," said an officer of a leading steel company, "we might have made fortunes in metals considered almost as common as dirt. The Chinese antimony is an example. When the war began, tons of it could have been bought in the Far East around 7 cents a pound. By the time the shipment would have reached San Francisco, the market was above 30 cents a pound. I don't know of a single man who bought then in anticipation of the rise."

—♦—
The production of gold, silver, copper, lead, and zinc from Nevada ores sold or treated in 1914, according to the United States Geological Survey, was valued at \$29,300,842.

In 1914 Nevada produced 60,986,450 lb. of copper, valued at \$8,111,198, a decrease from the production of the preceding year. The greater part of the copper, or 50,366,650 lb. came from concentrates, and 10,551,000 lb. were from crude ore shipped to smelters.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES

Bridgeport—Meets on the third Friday of each month at 260 John Street, Bridgeport, Conn. Secretary Nelson Barnard, 858 Howard Avenue, Bridgeport, Conn.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, S. Wrobeski, 1486 Elmwood Avenue, Buffalo, N. Y.

Chicago—Meets fourth Saturday of each month at 8 P. M. at Western Building, Randolph and Michigan Avenue. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Avenue, Cincinnati, Ohio.

Cleveland—Meets last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Avenue, Cleveland, O.

Dayton—Meets first Wednesday of each month at Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 First Street. Secretary, E. E. Miller, 543 Townsend Avenue, Detroit, Mich.

Indianapolis—Meets last Saturday of each month at the Denison Hotel. Secretary, Arthur Nelson, 1617 Shelby Street, Indianapolis, Ind.

Milwaukee—Meets first Friday of each month at Eagles Hall, 137 Second Street. Secretary, E. C. Yaeger, 962 Ninth Street, Newark, N. J.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 West Madison Avenue, Irvington, N. J.

New York—Meets fourth Friday of each month at 258-262 Pearl Street, New York City, at 8 P. M. Secretary, Wm. Fischer, 345 East 23d Street, New York.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Rochester—Meets second and fourth Friday of each month at University of Rochester. Secretary, C. V. Haring, 603 Dewey Avenue, Rochester, N. Y.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, F. Rushton, 4405 Blair Street, St. Louis, Mo.

Toledo—Meets every Wednesday at Toledo University. Secretary, James E. Nagle, 209 Navarre Avenue, Toledo, Ohio.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Society Notes

The monthly meeting of the Cleveland Branch was held Sept. 25. A good attendance was present. Among the visitors was Mr. Charles Proctor, who gave a very interesting talk. The Cleveland Branch of the A. E. S. extends a welcome to their meeting to platers to see the good work the society is doing for the platers and to listen to the discussions.

Mr. Fehren Wadsworth of Elyria, Ohio, will address the branch Oct. 30 on die casting plating. Plans are under way for an anniversary banquet to be held in December. The date will be published later.

The regular monthly meeting of the New York branch of the A. E. S. was held Aug. 27. Mr. Emile N. Pintner of College Point, N. Y., was elected to active membership. The laboratory committee is making preparations for the coming winter season, and standard solutions will be made and analyzed, which will make it interesting for all members to attend. The members of the New York branch attended the National Exposition of Chemical Industries at Grand Central Palace Sept. 20.

The Milwaukee branch A. E. S. now meets at Eagles' Hall, 137 Second Street, the first Friday of the month. Secretary Yaeger anticipates a fine series of winter sessions to be devoted to practical talks.

New Publications

UNITED STATES MINING STATUTES. ANNOTATED BY J. W. THOMPSON. PART I, SECTIONS AND STATUTES RELATING TO METALLIFEROUS AND COAL MINING. PART II, MISCELLANEOUS MINING SUBJECTS. ISSUES OF THE DEPARTMENT OF THE INTERIOR, BUREAU OF MINES.

These are two volumes of nearly two thousand pages each, and are of decided practical importance to those whose business interests touch on these subjects.

MEAKER GALVANIZING. BOOKLET PUBLISHED BY THE MEAKER COMPANY, CHICAGO. This booklet is descriptive of the appliance and materials made by the company that are designed for the use of the plater.

AMERICAN SOCIETY FOR TESTING MATERIALS, YEAR BOOK FOR 1915, CONTAINING THE STANDARDS AND TEXTATIVE STANDARDS. EDITED BY THE SECRETARY, AND PUBLISHED BY THE SOCIETY, PHILADELPHIA.

This well bound and printed volume contains 756 pages, with a conveniently arranged index to subjects. There is much in the book of use to those who require standards in the plating trade, and the non-ferrous metal interest is well treated also.

NEW PUBLICATIONS BY THE BUREAU OF MINES, DEPARTMENT OF INTERIOR, WASHINGTON.

Among the recent technical papers issued, probably No. 97, "Saving Fuel in Heating a House," and No. 115, "Inflammability of Mixtures of Gasoline Vapor and Air."

JOURNAL OF THE FRANKLIN INSTITUTE FOR OCTOBER.

This number is unusually interesting this month in the matter of quasi-popular articles.

ROAD CONSTRUCTION AND MAINTENANCE. E. L. duPont de Nemours Powder Co., Wilmington, Del., publisher.

This book, while advocating and exploiting the use of explosives in the phases of road building, is aside from that a really valuable text-book on the subject of road making. It ought to be consulted by all who are interested in this important subject. A copy may be had on application.

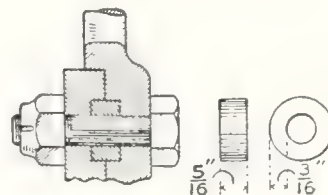
In "Foundry Philosophy" the Hill & Griffith Company of Cincinnati, etc., has put forth a prose-rhyme argument for the use of their specialties for foundrymen's use that is cleverly done. Not too much talk, and the point is well taken. A five-minute booklet that is food for thought.

The hardening of copper by the ancients has never been proved, although many statements have been made to that effect. The supposedly hardened copper implements are made merely of alloys of copper and tin. Often the lost art of hardening copper is bewailed as a real loss to the people of to-day, but the uses to which hardened copper could be put are not many. Its use for tools is only a myth, for with the price of copper many times that of steel no one would

buy the former even if it were as durable. Copper and brass are made much harder, or stiffer, by drawing, pressing, and hammering.

Preventing Flywheel from Breaking Fastening Bolts

It happens quite frequently that the bolts connecting the flywheel to the crankshaft flange shear off, due to their carrying an excessive strain. To pre-



vent trouble of this nature, insert a small drive collar on each alternate bolt. The flywheel and crankshaft are then counterbored, and the three collars securely pressed into them when the bolt nuts are tightened up. In this manner the three collars do the greatest part of the work, and therefore the bolts are relieved to a great extent.—*Popular Mechanics*.

The shortage of brass rods for shrapnel fuse timers has led to the use of several substitutes, among which are brass castings, steel, Tobin bronze, phosphor bronze and even aluminum. Die castings have been used for certain of the parts and with these the powder train groove does not have to be machined. It is said of shell-making, in general, that practically all of the early specifications have been abandoned, the one important qualification that is adhered to being the tensile strength of the casings.

The price for spelter has fallen a long way from 25c. per lb., but it is still at a high figure. Some producers talk as if they had been robbed of something rightfully belonging to them in that they can no longer sell their output at 20@25 cents per lb. They forget that it is scarcely eight months ago that zinc was selling under 5 cents per lb., and that a normal price for zinc—based upon averages for long periods, the cost of production, etc.—is regarded as being about 5@5½ cents per lb.—*Engineering & Mining Journal*.

EQUIPMENT FOR FOUNDRY AND PLATING ROOM

Something new in Automatic Plating Barrels—A Grinder for cinders and foundry refuse—An Electrical Pyrometer

An Automatic Plating Barrel

Mr. Potthoff, the president of the U. S. Electro-Galvanizing Co., is also a very active inventor whose ideas have taken form in a way that marks great advancement in the art of plating. The automatic plating barrel here illustrated and described is a very interesting mechanism, as it marks a higher plane in methods. Its success and reception have been gratifying to its makers. It is designed to handle material of medium size in quantity. Nails, screws, rivets, stampings, etc., are readily handled in the barrel.

The inventor claims to have secured basic patents. His latest efforts mark his greatest progress, as shown in the barrel plating apparatus in connection with automatic cleaning and drying appliances. By a continuous operation plating, washing, drying and delivery of the material is automatically accomplished. This barrel is made and sold, of course, only by the U. S. Electro-Galvanizing Co. It has been named the U. S. Junior Patent Automatic Self-Emptying Plating Barrel.

The entire equipment includes the plating barrel suspended on top of a tank and a machine in which the material is washed, after being plated, drained and dried.

The plating barrel is constructed of a special composed material which is similar to black hard rubber in appearance, but has almost the tensile strength of metal. The material is absolutely non-absorbing, and therefore, non-conducting. This means much to the plater.

The material is nearly indestructible, making a repair bill a rare document.

The material to be plated is shoveled in the plating barrel by a mere laborer. Fig. 1 shows the barrel when filled. The starting lever is moved and the plating begins. This automatically closes the door panel on the barrel. It is operated at a speed of from four to five revolutions per minute. The workman then places a receptacle at the end of the ma-

chine, where the finished product is to be ejected. One operator can attend to three or four barrels. The time required for plating the material is from thirty to sixty minutes, depending upon the thickness of the coat required. An average coat can be applied in about 30 min. When the plating is completed, the operator throws the belt on the loose pulley. Two or three turns of the barrel in the opposite direction automatically empties

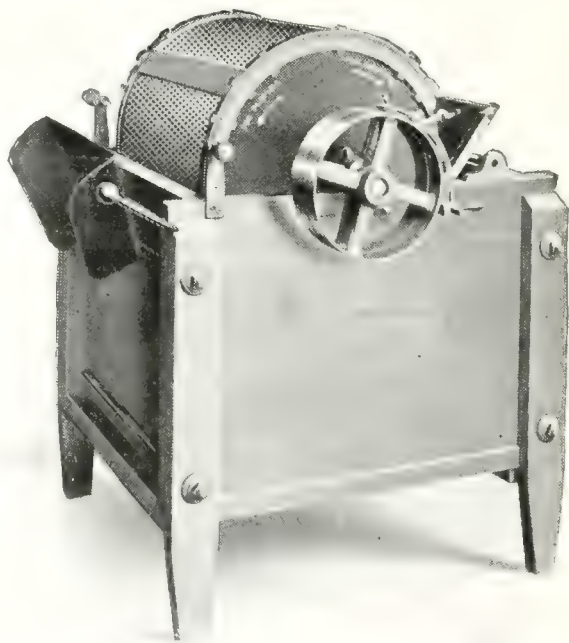


Fig. 1—Barrel in Position for Filling

the material into the receptacle or into the washing and drying drum. This is shown in Fig. 2.

After the material is delivered in a receptacle, it is afterward handled in the usual way, by drying the sawdust, etc., but if the washing and drying device is used, which is in direct connection with the barrel, the material is emptied into the washing drum of this apparatus, the barrel refilled, and again started for plating, which also starts the washing and drying device. While the second batch is being plated, the first batch is automatically washed, drained, and dried. If tumbling or polishing of material is required, the dried articles can be delivered automatically into a polishing drum, from where it is removed, completely fin-

ished. Therefore, all handling labor can be saved. It is only necessary, in this case, to shovel the material into the plating barrel and remove same from the polishing machine completely finished.

The washing and drying apparatus is thus described: It consists of three drums: a washing, draining, and drying drum. The complete batch, which has been delivered into the washing drum as the product is washed, is delivered a few pounds at a time into the draining drum, and from there, also a few pounds at a time, it is carried into the drying ap-

greatest wear, which gives it double thickness at these points without being clumsy and causes it to stand up well under the heat. It is held together with heavy rivets, which prevent tearing, and add greatly to its wearing qualities.

Metal Goods and Parts by Contract

The manufacture of metal goods and metal parts by contract is now becoming one of the important industries of the United States. Thousands of concerns, including some of the largest in the country, find it far cheaper and better

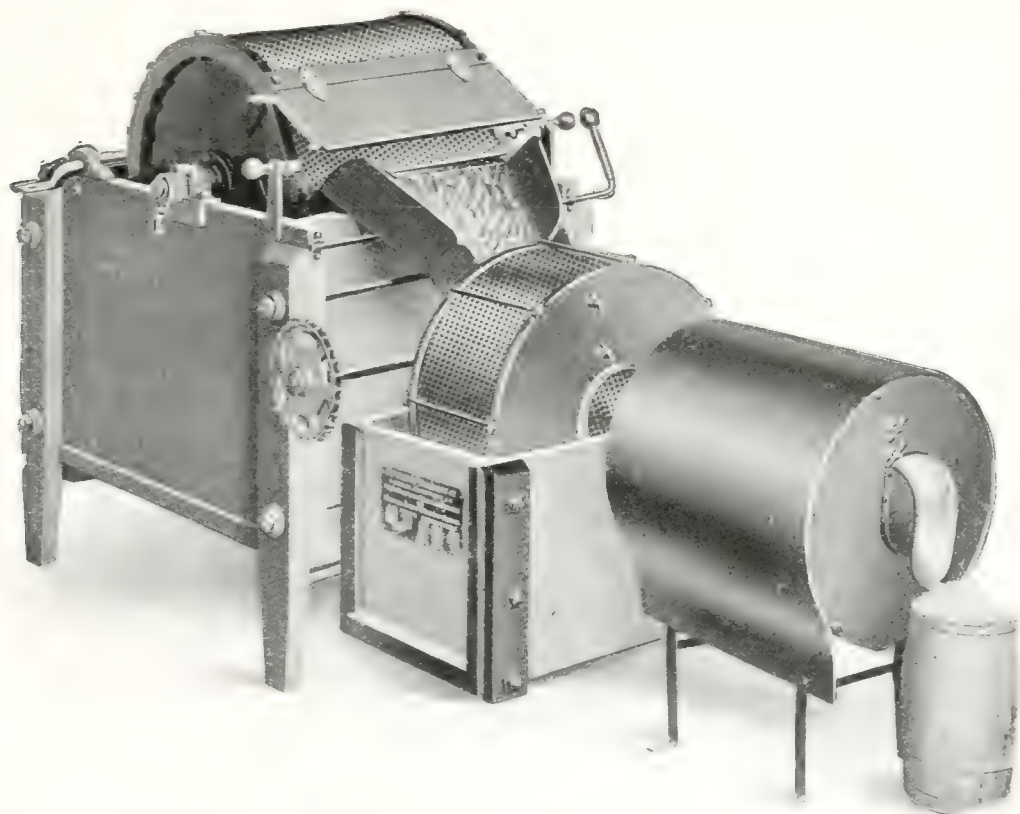


Fig. 2—Automatic Self-Emptying Washer and Dryer attached to U. S. Junior Plating Barrel under Operating Conditions

paratus. This is the last compartment of the machine, and consists of a drum with an inner separate cylinder.

Safety Mittens for Foundry Use

The use of safety mittens in foundries, rolling mills, etc., is now becoming quite general, and the demand for a satisfactory article of this kind has lead Sturges Bros. of Wilton, Conn., to place on the market a very superior mitten for this purpose.

The Sturges safety mitten is heavy and very substantially made of chrome tan cowhide with patches on the parts of

in many ways to contract for work of this kind rather than to install a lot of expensive machinery and manufacture it themselves.

One of the best known firms manufacturing metal goods by contract is the Enterprise Manufacturing Co. of Akron, Ohio, who has been in this business since 1881 and during that time has gradually increased its manufacturing facilities until its factory is now one of the largest and best equipped plants devoted to this class of work in the country.

The Enterprise Manufacturing Co.

manufactures a wide range of metal goods, including metal stampings, screw machine products, etc. It has also excellent facilities for buffing, polishing and plating work and special finishes of all kinds.

The Hardinge Conical Mill

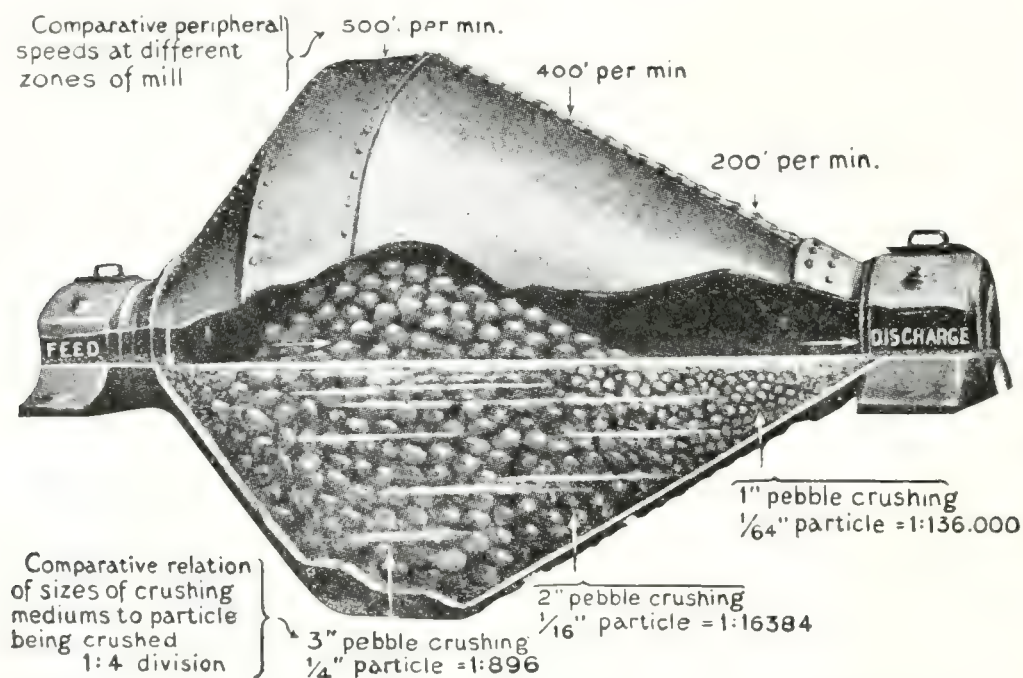
In this device the large crushing bodies arrange themselves at the largest diameter, decreasing in size toward the outlet of the cone, as shown in the illustration. Coarse material on entering the mill is immediately subjected to the impacts of the largest grinding bodies, is subdivided and, according to the division, passed along to the smaller grinders, and so on until the discharge is made.

In this machine the grinding mediums automatically adjust themselves to the

operate, has no screens or casings, is accessible, crushes wet or dry, and adjusts a large ball to crush a large particle and a small one to crush a small particle, the Hardinge conical ball mill has proved by actual service to be ideal.

In this mill the partly crushed material is immediately removed from the zone of action of the large balls and seeks a zone of balls suitable for the work, discharging from the mill as soon as it has reached the approximate size desired; both feed and discharge being automatic and no dumping barrel required.

As this mill automatically adjusts power to work its large capacity and small horsepower are accounted for. It can be adjusted to take material direct from the crusher, and in one operation reduce same so that practically all will



Hardinge Conical Ball Mill, showing how the grinding mediums automatically adjust themselves to the work to be performed

work to be performed, and comparatively speaking, a sledge hammer is used on a spike, a nail hammer upon a nail, and a tack hammer upon a tack, thus utilizing all mechanical forces with the greatest effect.

As is well known, the ordinary (old style) ball mill is expensive in initial cost, expensive in maintenance, is complicated and requires skilled labor to operate.

Because of its small initial installation and maintenance costs, and due to the facts that it requires no skilled labor to

pass an 8, 10 or finer mesh if desired without the use of screens.

Hardinge conical ball and pebble mills are the result of thirty years' experience gained in investigating and operating ore-treating plants and central service has proved them to be not only the simplest type of grinding machine, but the most economical and efficient.

The Hardinge ball mill, which is used with the greatest success in the largest brass foundries, is fully described in Booklet No. 6, issued for free distribution by the Hardinge Conical Mill Com-

pany, 50 Church Street, New York. This publication and their booklet, "Extracts from the Technical Press," are well worth sending for by all whose problems include the economical grinding of material.

Pyrometers for the Foundry

The Thwing Extensible Thermocouple, shown in Fig. 1, has been found to solve in a most economical and efficient manner the important problem of accurately measuring the temperature of molten brass and copper.

The junction of the two wires, extending beyond the tubing, is made by the user by cleaning the two elements and twisting them firmly together. The junction thus formed is dipped a few inches into the molten metal, and a reading of the temperature is secured in a few seconds.

The Thermocouple is then withdrawn and may be used for ten or twelve readings before the molten metal destroys the junction. When this takes place, the wires are drawn down from the reserve supply carried above the tubing, a new junction formed, and the Thermocouple used as before. Only two or three inches of wire are consumed in ten or twelve readings, and as a reserve supply of 25 ft. of heavy or 50 ft. of light wire is carried by the instrument, the Thermocouple will last for an indefinite period.

Managers who have given attention to the subject appreciate the value of keeping a continuous chart record of the temperatures in core ovens and anneal-

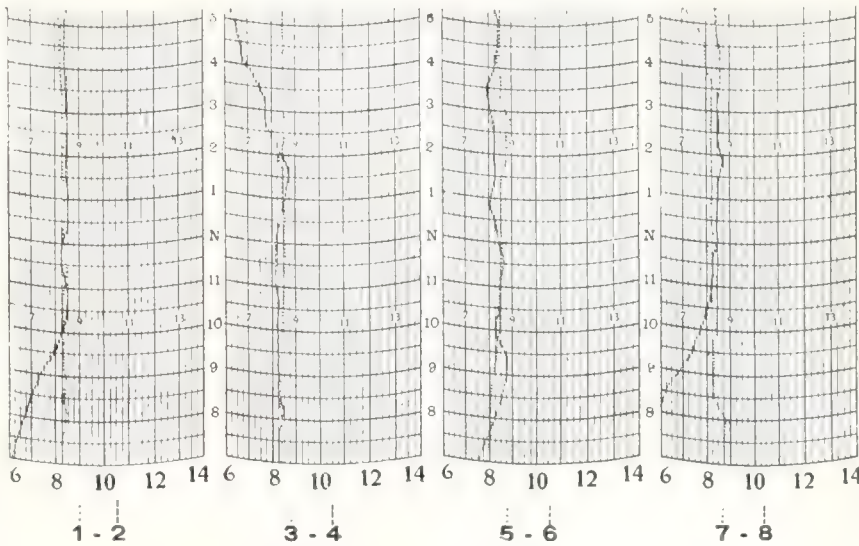
ing furnaces, yet many are deterred from the use of such recorders by the expense of a number of instruments to cover all of their furnaces.

Not only have Thwing Multiple Record Recorders proved the solution of the problem of securing the necessary number of records without exorbitant initial cost, by making it possible to get continuous distinguishable records from as many as twelve furnaces on a single chart, but both time and expense of up-keep are saved.

On these Multiple Recording Recorders from one to four galvanometers are mounted side by side, each needle making from one to three records which are distinguishable as the records from one



Fig. 1
Thwing
Extensible
Thermocouple



THWING ELECTRICAL PYROMETER
THESE INSTRUMENTS TO BE USED
PATENTED BY THWING INSTRUMENT CO. N.Y.

Fig. 2—Eight record chart

furnace is shown by dots, another by dashes. A sample eight-record chart is shown in Fig. 2.

The Thermocouples are mounted permanently with respect to the recorder, the record for each furnace being accomplished by an automatic switching device actuated by clock mechanism.

A four-record recorder of this type has been in successful use in the core oven of the Cramp shipyards for the past four years, and the pyrometer for molten brass has been used for a long time by Haines, Jones & Cadbury of Philadelphia and by the American Bronze Co., Berwyn, Pa., among others.

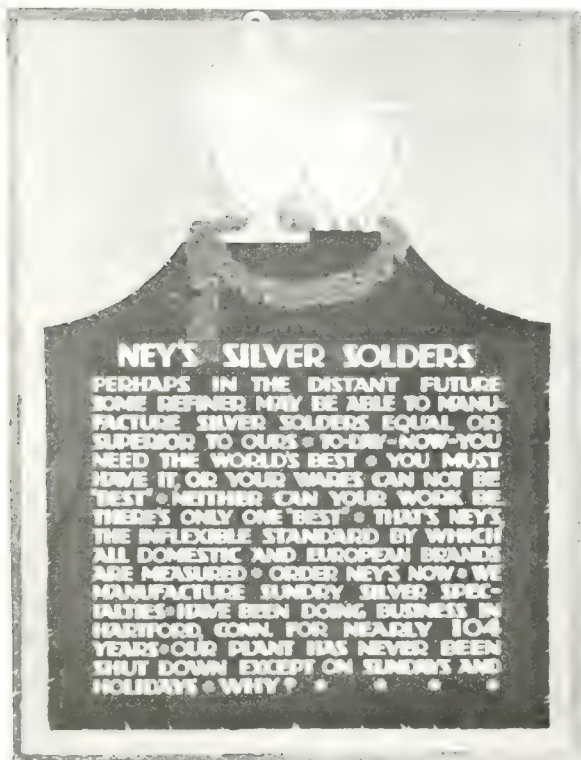
This instrument is manufactured by Thwing Instrument Co., 445 North Fifth

Street, Philadelphia, Pa., who have issued a book on "Pyrometers for Metal Workers," which should be read by everyone interested in the subject.

Ney Gold Products

The Dental Congress was an occasion for a characteristic display on the part of the J. M. Ney Co. of Hartford. We have called attention to some of the items previously, but the display of "The First American Gold Refinery" was as various as could be anticipated. As pioneer in the manufacture of platinum, gold and silver solders its products always carry interest when displayed. All the arts and trades requiring high standards in such goods are sure to know the Ney brands. The company claims that no platinum solder will do what Ney's does, and the names of users prove these solders satisfy exacting buyers.

The booth presented an array of arti-



cles indispensable to the craft. One side carried a decoration of Ney's pure gold foil, ten feet long and approximately eight feet high. In the form of an oval was a sign reading "Ney's Jewelers' Golds, Best Since 1812, Hartford, Conn., U. S. A." On the other side were four original sketches done in complementary tempora devoted to gold, platinum and silver solders, and to platincy, the com-

pany's newest specialty, which replaces platinum for many purposes. The company was represented by R. B. Wells, L. J. Weinstein and H. D. Simpson.

A sign called attention to the fact that the company invites consignments of old precious metals and offers always an assured market for any quantity, no matter how large or small.

It might be thought that after nearly 104 years of strenuous activity this venerable concern would rest on its hard won laurels. But the reverse is the case, for it knows no rest in serving acceptably manufacturing jewelers and repairers.

TRADE NOTES

It is stated that the Crown Cork & Seal Company, Baltimore, is planning to erect a foundry at its Guilford Avenue plant.

The Brown Instrument Co., Philadelphia, has just let contract for further extension and addition to present premises, comprising 50 per cent additional floor space. This is on top of a recent enlargement that was necessary to supply the demand for Brown pyrometers for the control of high temperatures.

The Gorham Mfg. Co. has contracted for three buildings as additions to Providence (R. I.) plant. The new work will mean additional space in the bronze department, which has become a large feature of the work.

American Sheet Metal Works in New Orleans has ground broken for the erection of a new plant. It will be 150 x 300.

Nickel coins in Belgium and Germany are being called in. Zinc coins are to be substituted.

D. J. Barber Foundry Co., Bridgeton, Canada, is about building a new foundry building to be 100 x 250.

A voluntary petition in bankruptcy has ben filed by Silvey, Bugden & Silvey, Boston. They are tin, brass and copper workers.

Contracts have been let for an addition to the Nolte Brass Co. brass

foundry. Adjoining the present brass foundry they will erect a \$15,000 foundry building which will double floor space in this department. The building will be 50 x 210 ft., of steel and concrete construction, and strictly up to date for foundry purposes.

Alonzo Rothschild, founder of the *Jewelers' Weekly*, died by drowning Sept. 29 on his estate at East Foxboro, Mass.

The Ramey Company, Chillicothe, Ohio, manufacturer of electrically-operated vacuum cleaners, expects to increase its manufacturing facilities at an early date.

The Federal Brass Works in Detroit have taken over the plant of the Brass and Aluminum Foundry & Machine Co. They will specialize in babbit-lined bearings, bronze bushings, priming cocks, drain cocks and any cast brass parts for gasoline engines.

A bill has been approved by the Governor of Illinois to the effect "That every employer of labor in this State, engaged in the manufacture, repairing or altering of any metals, wares or merchandise which may produce or generate poisonous or noxious fumes or dusts in harmful quantities, such as metal polishing, grinding, plating and dipping of metals in acid solutions or dips, are hereby declared to be especially dangerous to the health of the employee so engaged. Such manufacture, repairing or altering of any metals or merchandise in such processes and places of employment shall be conducted in rooms lying wholly above the surface of the ground."

Work is being pushed at the old so-called C. B. Rogers shop, Norwich, Conn., for the Norwich Nickel & Brass Co. to move into it from their quarters on Chestnut Street. Edwin A. Tracy is treasurer and general manager of the company.

Manhattan Brass & Electrical Co. has moved to 199 Grand Street, New York.

A campaign to improve conditions for workers in the metal polishing trades is to be inaugurated throughout New England, it has been announced, following a meeting of the general executive board of the metal polishers.

The International Nickel Co. is receiv-

ing enormous orders for nickel, its by-products, and copper. The company owns the most extensive known existing nickel ore deposits. Its patented nickel lands in the Sudbury district cover 100,000 acres, and in addition to this the company owns the town of Copper Cliff, where it has an up-to-date smelting plant. It also owns the shares of the Societe Miniere Caledonienne of New Caledonia, which company owns extensive nickel lands. These lands, it is estimated, will furnish the company with at least sixty years' ore supply.

A sustained movement toward industrial recovery from the depression of last year is indicated in returns concerning employees and wages in 1914 and 1915, received by the New York State Industrial Commission from representative manufacturers throughout the State, according to a bulletin issued by the commission yesterday. Corresponding weeks in the two years were used for comparison, and 1300 firms with more than 400,000 employees, or approximately one-third of the factory employees in the State, were selected so as to represent all the more important industries.

The reported sale of 15,000,000 lb. of copper to Union Metallic Cartridge Company is the first large transaction with domestic consumers for some time, although the brass mills and munition makers have bought a larger tonnage than is appreciated.

Demands made by the employees in the polishing and grinding departments of the Corbin Screw Corporation, New Britain, Conn., were granted at a conference of the company, who said that the demands seemed so reasonable there was no reason why they should not be conceded. The men asked that the old scale of wages, under which they would be allowed to make \$3 a day instead of the \$2.50 they have been making, be put in force.

The Chase Metal Works, Waterbury, Conn., has started work on additions to its plant on Thomaston Avenue. A brick and steel factory building, 140 x 180 ft., one story high, will be built; also three additions, 60 x 260 ft., 60 x 320 ft. and 60 x 120 ft., all two stories high. There

will also be two other brick additions, 60 x 160 ft. and 60 x 200 ft., two stories high; also two additions, 60 x 80 ft. and 60 x 120 ft.

A new and larger anode factory is now a fact with the Apothecaries Hall Co., Waterbury, Conn., because the one established in 1912 was outgrown and overcrowded. The new quarters naturally make the latest improved practice a reality. Patterns, shapes and sizes of anodes are uncommonly plenty and of all required percentages of purity. The chemical supervision afforded by an effective laboratory is one of the facts that assure superiority.

Stockholders of the New Jersey Zinc Co. at a special meeting voted unanimously to approve the increase of capitalization of the company from \$10,000,000 to \$35,000,000. The \$25,000,000 new stock is to be distributed to stockholders as a 250 per cent stock dividend. The company's surplus at the present time is about \$27,000,000.

F. N. Dubois, head of the plumbing supply firm of F. N. Dubois & Co., of New York, died July 8 at his home, in Catskill, N. Y., at the age of eighty-six. Mr. Dubois had been engaged in business in New York since 1876, and one of his inventions is notable in the plumbing trade.

The Board of General Appraisers sustained the Beardslee Chandelier Mfg. Co., Chicago, in a contention relating to the classification of chandeliers, fixtures and brackets composed of metal. The collector returned the articles at the rate of 50 per cent ad valorem of the tariff, as manufacturers of metal, gold-plated. It was claimed that the goods were not so plated, and should be allowed to enter at 20 per cent ad valorem as plain metal manufactures. As the testimony of the importer's witnesses was uncontradicted by the Government the higher assessment was reversed.

The American Enamel Manufacturing Corporation of New York has purchased the old plant of the Colwell Lead Company for a factory. The company will manufacture cast-iron pipe and fittings, enamel bathtubs, sinks and lavatories.

The property of the bankrupt United States Metal Products Co., which failed last November owing \$1,008,550, was sold at auction in New York under direction of referee in bankruptcy. There were forty-seven parcels, and the amount realized was

\$216,027. The creditors' committee bid \$204,000 for most of the parcels, and the other parcels went to outsiders for \$12,027.

Work has begun on the new million-dollar structure of the Coe brass branch of the American Brass Co. at Torrington, Conn.

The Autocar Company, Ardmore, Pa., has prepared plans for another large addition to its plant which will be rushed to completion.

The Hartford Automobile Parts Company, manufacturer of universal joints and clutches, Hartford, Conn., is seeking a new location in that city. It is one of the four tenants of the west armory of the Colt's Patent Firearms Company.

The Auburn Button Works, Auburn, N. Y., have let the contract for a manufacturing building, 48 x 100 ft., two stories and basement.

United States Nickel Company, New Brunswick, N. J., has built a large extension to the present building and installed several new smelter furnaces, besides purchasing additional land for further growth.

The Detroit Metal Refining Co., a new enterprise, has occupied the old Keeton factory, which has been modernized, and it will operate with 48 furnaces. Sol Sadek, for years general manager of the Progressive Metal & Refining Co. of Milwaukee, will direct the business of the new company and make his future residence in Detroit. He will, however, retain his interests in the Progressive Company. Besides Mr. Sadek, the officers of the new company are: I. Gerson, president; L. R. Grosslight, treasurer, and S. Gerson, secretary.

The Metals Coating Co. of America has opened an office in New York City in charge of E. McFarlan, and another in Boston managed by H. Jaques, Jr. The Schoop process is a promotion of the company.

The Warner Silver Company, Bridgeport, Conn., announces that it is now equipped for doing gold and silver plating in large quantities for the trade. It makes a specialty of this class of work. It also does plating in nickel, brass and copper.

The Standard Aluminum Company, Two Rivers, Wis., announces the retirement of William Bremer as president and the succession to that position of Herman Wentdorf, until now secretary. Mr. Wentdorf is succeeded by Louis Gloe.

A new process of welding metals, named vollanizing, after the inventor, is now in operation. It is an electric method of welding and much that is new and unusual is claimed for it.

Solid Drawn Forging Co., at Pittsburgh, is new. Other metals than steel are also made. W. H. Lamon, E. B. Strassburger and K. A. Martin are the incorporators.

Shields Pattern Works, Columbus, Ohio, have moved to a new and larger plant at 57 North Fourth Street. The works make models and patterns for iron, brass, steel and aluminum.

The strike at the metal goods works of H. A. Matthews Mfg. Co., Seymour, Conn., is for the fifty-five-hour week and 10 per cent advance.

There was filed for record at Jersey City, N. J., a deed whereby the New Jersey Zinc Company transferred to August Heckscher of Huntington, Suffolk County, N. Y., its Kearny works, located on the west shore of the Hackensack River, adjoining the Newark and New York plank road. The plant consists of a large zinc refining works, contains twelve and one-half acres of land and has a frontage along the river front of 930 ft. and a depth of 917 ft. The sale included all the buildings and machinery. The price paid was not made public.

Portsmouth Navy Yard will become the smelting station for the navy on the Atlantic coast. The work will not interfere in any way with the regular output of the yard foundry, as it will be a separate undertaking.

The James H. Still Co., New York City, whose metal cleaner "Stilline" is so favorably known, has issued a new four-page leaflet on the subject that includes directions for use. The company also makes Per-xl metal cleaner, which is a compound particularly adapted for jobbing platers in removing paint, lacquers, hardened oxide, etc., from articles to be replated. In addition to their specialties they distribute rouge, white nickel finish, buffing tallow and a number of such useful products.

The Cleveland Blow Pipe & Mfg. Co. has moved to 6302 Kinsman Road, Cleveland, in order to double factory

space and facilities. The orders for dust collectors, and the popular ventilating system, both the company's products, have been most gratifying. Manufacturers in most fields of endeavor are beginning to appreciate the necessity of using such apparatus on about all classes of machinery. The sheet metal guards for covering dangerous parts of machines are a part of the general sheet metal work of the company. The change of location was effective Oct. 15.

Trade Opportunities

The names and addresses of subscribers who have sent in any of the following inquiries will be furnished to any of our advertisers on application.

INQUIRY No. 29—SOLDERING MACHINE

I am looking for a soldering machine that can be used to good advantage at home for soldering scarf pins and cuff links, etc. I answered some of the ads in your magazine but failed to get the necessary information, so thought I would write you, as I think you might be able to help me find a machine of this kind.

INQUIRY No. 31—BROKEN CRUCIBLES

We are interested in getting the names of buyers of broken crucibles, as we frequently have these for sale.

INQUIRY No. 32—FURNACE FOR MELTING ALUMINUM

What kind of furnace do you consider the best and most economical for the melting of aluminum?

INQUIRY No. 33—GREY IRON CASTINGS LIGHT WORK

We are in the market for a quantity of grey iron castings light work, which must be reasonably soft—that is, soft enough to drill, to consist of lock cases, caps and tumblers, and would ask for your best price per pound, same to be made in ton lots f.o.b. and spot cash.

We expect to use a large quantity of these and are unable to get satisfactory service in our local foundries, as they are not fitted up for small work.

CLASSIFIED ADVERTISEMENTS

Advertisements for Situations Wanted published free of charge for subscribers. Help Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars.

For Sale

FOR SALE OR RENT—One block from City Hall, Buffalo, a modern brick mill-constructed machine shop and brass foundry building. Five floors 63 ft. x 70 ft. Light on all sides. Natural gas for furnaces and Niagara Falls electric power. Address G. B. Bassett, 291 Terrace, Buffalo, N. Y.

FOR SALE—One type S.H. 1500-amp. 6-volt Zucker & Levett & Loeb generator. Practically new, used only eight months and in excellent condition. Write Indianapolis Stove Company, Indianapolis, Ind.

SMALL electroplating outfit used two months. Address Box 9, care of Brass World, Edison Bldg., New York.

Bone and Ivory Chips Wanted

WANTED—Bone and ivory chips or dust, waste of manufactured articles of bone and ivory. Send prices and samples, also quantities produced. Will pay cash for the right materials. Address Box 14, Brass World, Edison Bldg., New York.

Help Wanted

YOUNG MAN WANTED—With some knowledge of plating, to represent chemical and supply house on liberal commission basis, in New York. Address Box No. 1033, Brass World, Edison Bldg., New York.

SALESMAN WANTED—To take care of New England territory. Must have a knowledge of the plating and finishing trades, acquaintance with the territory not necessary, but must have good references. Most liberal commission basis only. Good opening for the right man,

one who has confidence in ability to make good. Address Box 1029, Brass World, Edison Bldg., New York.

SALESMAN—Concern in the West making plating and tumbling machinery and selling plating supplies, wants first-class salesman for the Eastern territory. Must be a practical plater and able to demonstrate the apparatus. Address Box 501, Brass World, Edison Bldg., New York.

WANTED—Chemist, experienced in conducting chemical and physical tests of steel. Man with experience in electrolytic chemistry preferred. State references and salary expected. Address Box 10, Brass World, Edison Bldg., New York.

Situations Wanted

FOREMAN PLATER—Who needs a foreman plater of seventeen years' actual experience in all popular finishes in gold, silver, nickel, copper, brass, bronze, tin, lead? Who has hardware that must be produced economically? Who has something hard to do in the plating line and is willing to back up a competent man in fitting up a plant to defy competition? Who has die-castings to plate in any metal with not more than five per cent loss? I will take your hardest proposition, and if it can be done I will do it. I am for sale. Address Box 1031, Brass World, Edison Bldg., New York.

MOLDMAKER—Twenty years' experience in designing and modeling trimmings for britannia hollow ware, chas-ing and fitting molds and dies; Al on toilet ware, dies and forces. Address Box 1027, Brass World, Edison Bldg., New York.

POSITION WANTED by a first-class brass foundryman, experienced in plumbers' supplies, valve work, builders' hardware and general jobbing. Address Box 1032, Brass World, Edison Bldg., New York.

NICKEL PLATER—Over 20 years' practical experience in plating, polishing and buffing. At present occupied, but desires position with manufacturing plant as superintendent; or foreman of the above-named departments; best of references. Address Box 1028, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Nineteen years' experience as plater, polisher, buffer, lacquerer and japanner; also good knowledge of chemistry. Am open for a position; can handle men to employer's advantage. Experienced in working on every solution known to the trade. Best results guaranteed. Will go anywhere in the United States. Best of references. Address Box 1030, Brass World, Edison Bldg., New York.

PLATER—A No. 1, steady and reliable; have a broad experience with a large variety of work, including on nickel, brass, copper, bronze and zinc, and a little silver and gold plating. Tinning; all kinds of oxidizing and lacquering. At present employed. Would make a change to good, reliable concern. Can handle piece or day work help to advantage. Address Box 1025, Brass World, Edison Bldg., New York.

PLATER—I understand plating, polishing, buffing, lacquering and oxidizing of all metals. Can also nickel plate sheet zinc and castings. Address Box 926, Brass World, Edison Bldg., New York.

PLATER—Married; fourteen years' experience at all finishes, gold, silver, nickel, copper, brass, bronze, oxidizing, etc.; make all solutions. Have had wide experience on various articles of manufacture. Steady and sober; quick worker. Will leave city, if permanent position. Address Box 922, Brass World, Edison Bldg., New York.

PRACTICAL PLATER — Foreman plater with electrochemical knowledge desires to connect with a reliable firm where

his knowledge would be useful. At present employed as foreman of a plating, polishing and finishing department. Want to make change. Address Box 918, Brass World, Edison Bldg., New York.

UP-TO-DATE PLATER—Want employment with manufacturer who desires practical man, thoroughly understanding the reactions of solutions of all metals, and who can produce work satisfactorily and economically. Will take hardest proposition and work it out if it can be done. Want only a reasonable salary, but want to get located. Address Box 924, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Have twenty-two years' experience; can take charge of polishing and buffing departments; have good references; thoroughly up-to-date on all solutions and finishes; mechanical plating and polishing barrels; can handle help to advantage and show results. Address Box 921, Brass World, Edison Bldg., New York.

BRASS FOUNDRY FOREMAN—Wanted position as foreman or assistant in brass or aluminum foundry. Familiar with metal mixing machines and all up-to-date methods of molding. Wide experience; good references. Address Box 15, Brass World, Edison Bldg., New York.

PRACTICAL MAN — Understanding plating, polishing, buffing. Over twenty years' experience. Wants place as superintendent or foreman of departments named in a manufacturing plant. Best references. At present engaged, but desire to change. Address Box 12, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Experienced man can take charge of polishing and buffing; has good reference from last place, where I had charge of the plating department in fancy brass goods. Experienced on such goods as chafing dishes, percolators and electro tin, also silver plating. Address Box 4, Brass World, Edison Bldg., New York.

PLATER—First-class; steady. Can mix and run all solutions, barrel and still plating. Ball burnishing, etc. Desires to change. Moderate salary. Address Box 11, Brass World, Edison Bldg., New York.

Current Metal and Supply Prices

It is impossible in giving a list of current prices of metals and chemicals to do more than to furnish quotations which are approximately correct at the time of going to press. The prices of many of the items included below are influenced by war and other conditions which make them unstable at the present time.

A Review of the Old Metal Trade for September, 1915

A thread of uncertainty wove itself throughout the metal fabric during the past month. The market was featured by constant fluctuations up and down, in copper and tin, and even in spelter, while the trend was downward, that trend was interrupted by reactions. Lead's descent was orderly from beginning to the present. Antimony had very little change. The feature of the month, head and shoulder above any other, was aluminum, which advanced steadily without a break to its present high point.

The old metals are so closely allied to the new that it is but natural to review the new along with the old. Hence the above remarks, preceding those of the old, are but proper for a better understanding of the scrap metals. On the whole there was visible improvement. General evolution favored this. War-orders improvement in the iron and steel trade, our immense crops, and finally the consummation of the big war loan. As a result, the scrap metal trade is in fair condition to-day, though the real domestic trade is still far behind. On the whole, prices have changed very little, excepting in zinc and aluminum. The principal change was in the aluminum.

The export of old metals has been comparatively small. Up to a year ago the export trade monopolized the larger percentage of our local scrap metal business. To-day it has reached a minimum. As said previously, the changes in prices in the copper and brass scraps were almost insignificant. On Aug. 30 the scraps (copper) ranged from 13-13½ for the light copper and 15-15½ for the heavy copper. To-day they are 13½ to 13¾ for the light and 15 to 15½ for the heavy copper scraps. Composition scrap 11½ on the 30th of August and 12 to 12¼ to-day. Heavy (yellow) brass scrap was 9¾ to 10. To-day 10¼ to 10¾. No. 1 brass turnings 11½ to 12. To-day 12 to 12½. Composition turnings were 11 to 11½. To-day 12 to 12½. In the latter, a better domestic demand has sprung up, and they had heretofore been unduly depressed. Brass clippings, which had weakened at the end of last month, became firmer, and to-day are 12½ to 12¾. Aluminum scraps, which had climbed to 23 to 24 for the old, and 26 to 26½ for the new, jumped each, so that to-day the scraps are 32 to 34 for the old and 35 to 37 for the new. The lead and type scraps remained about the same. During the month a brisk demand arose for the type scraps, especially the electrotpe and the market advanced about ¼ cent. Tin and solder scraps were weaker in sympathy with the new tin metal. The volume of business, though we have no date to go on, remained about the same. Throughout the month there was a fair movement, especially in the copper scraps. In combination some large transactions took place. The zinc scraps took a back seat, a seat very, very far back. Prospects look bright for the remainder of the year, barring unforeseen disaster.

SALIE B. MOERS.

CHEMICALS

Acetone, pure 98-99 per cent.	.35 lb.
Acid, acetic, pure 30 per cent.	.03¼ lb.
Acid, arsenious (white arsenic)	.10 lb.
Acid, boracic (boric), pure	.15 lb.
Acid, hydrofluoric, 48 per cent.	.40 lb.
Acid, muriatic, 20 deg.	.02¼ lb.
Acid, muriatic, c. p., 20 deg.	.07¼ lb.
Acid, nitric, 38 deg.	.05¾ lb.
Acid, nitric, 40 deg.	.06 lb.
Acid, nitric, 52 deg.	.09¼ lb.
Acid, nitric, c. p.	.10 lb.
Acid, sulphuric, 66 deg.	.02¼ lb.
Acid, sulphuric, c. p.	.07¼ lb.
Alcohol, wood	.55 gal.

Alcohol, denatured	.44 gal.
Alum, burnt and powdered technical	.04 lb.
Alum, commercial	.06 lb.
Ammonium sulphate	.04½ lb.
Ammonia water (aqua-ammonia), 26 deg.	.09 lb.
Ammonia water, c. p.	.10 lb.
Ammonium carbonate, lump	.09½ lb.
Ammonium chloride (sal-ammoniac)	.12 lb.
Ammonium hydrosulphuret	.25 lb.
Ammonium sulphate	.07 lb.
Amyl acetate	3.25 gal.
Antimony (fine powder)	.32 lb.
Arsenic, metallic	.10 lb.
Arsenic, white (acid arsenious)	.04½ lb.
Bismuth, metallic	3.00 lb.
Blue-vitriol	.07¼ lb.
Borax, crystals or powdered	.12 lb.
Borax, powd., refined, bbl.	.05¾ lb.
Borax, lump, refined, bbl.	.05¾ lb.
Borax glass	.30 lb.
Carbon bisulphide	.20 lb.
Calcium carbonate (precipitated chalk)	.05 lb.
Chrome-green, c. p.	.26 @ .30 lb.
Cobalt, metallic, pure and carbon free	2.50 lb.
Cobalt, black peroxide	1.50 lb.
Copper carbonate, dry	.23 lb.
Copper, sulphate (blue-stone)	.12 lb.
Copper trisalyt	.30 lb.
Copper cyanide	.45 lb.
Cyanide, see Potassium cyanide	.30 lb.
Dextrin	.15 lb.
Emery flour	.05 lb.
Emery, F F & F F F	.03 lb.
Flint, powdered	25.00 ton
Fluorspar	30.00 ton
Fusel-oil	3.50 gal.
Gold chloride	11.75 oz.
Gold trisalyt	10.00 oz.
Iron perchloride (110 lb.)	.20 lb.
Iron sulphate (copperas)	.05 lb.
Lead acetate (sugar of lead)	.17 lb.
Lead, red (pure)	.15 lb.
Lead, yellow oxide (litharge)	.15 lb.
Nickel and ammonium sulphate (double salts)	.08¼ lb.
Nickel carbonate, dry	.60 lb.
Nickel, metallic	.60 lb.
Nickel sulphate (single salts)	.20 lb.
Nitre (saltpetre), see Potassium nitrate.	
Oil of vitriol, see Acid, sulphuric.	
Paraffin, high viscosity	.19 @ .26 lb.
Phosphorus	.35 @ 1.00 lb.
Pitch	.05 lb.
Plaster of Paris, dental	.05 lb.
Potassium bichromate, c. p.	.50 lb.
Potassium carbonate	.39 lb.
Potassium cyanide chloride mixture	.23 lb.
Potassium iodide	3.75 lb.
Potassium permanganate	1.25
Potassium, red prussiate	2.50 @ 2.75
Potassium sulphate (liver of sulphur)	.20 lb.
Pumice, ground	.05 lb.
Rochelle salts	.27½ lb.
Rosin, yellow	.08 lb.
Silver chloride, dry	.65 oz.
Silver cyanide	1.00 oz.
Silver nitrate, crystals	.45 oz.
Silver trisalyt	.24 oz.
Soda-ash	.05 lb.
Sodium bisulphite	.01¼ lb.
Sodium carbonate (sal-soda), crystals	.00¾ lb.
Sodium hyposulphite ("hypo")	.03 lb.
Sodium nitrate	.01½ lb.
Sodium phosphate (crystal)	.02¼ lb.
Sodium silicate (water-glass)	.05 lb.
Tin chloride	.43 lb.
Turpentine, spirits of	.55 gal.
Wax, beeswax, yellow	.37 lb.
Wax, carnauba	.45 @ .47 lb.
Whiting (ground chalk)	.05 lb.
Zinc, carbonate, dry	.30 lb.
Zinc, chloride	.15 lb.
Zinc, cyanide	.70 lb.
Zinc, sulphate	.07 lb.
Zinc (spelter)	.22 lb.
Zinc, trisalyt	.28 lb.

The Brass World & Platers' Guide

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Deoxidizing Brass and Bronze

When copper is melted it absorbs gases which, being partly retained as solidification takes place, impart a porous structure to the metal.

For this reason it is not commercially possible to make castings of pure copper, because in every case something must be added to the molten copper to remove these gases and thus insure solid castings.

As it is generally supposed that oxygen is the gas that causes this difficulty, the additions made to the copper for the purpose of insuring solidity are known as deoxidizers, which means oxygen removers.

It makes no difference how the copper is melted, the addition of a deoxidizer is necessary to insure sound castings. It is doubtful if it were melted in a vacuum whether the castings would be solid if they were not cast in a vacuum also.

Copper melted in an electric furnace and surrounded by an atmosphere of carbon monoxide gas is porous when cast in sand molds, although much less so than when cast from a fuel-fired furnace, which, of course, shows that the more carefully the copper is melted the less deoxidizer need be used, and the purer the resulting castings will be.

In melting copper to make brass or bronze the gases absorbed by the copper must be eliminated, otherwise the alloy, while it may not in every case be porous, will not be as strong as it would if the gases had been removed. This is due to the fact that the gas may have united with one of the metals forming the alloy and have become a solid; therefore, while there are no visible gas holes, a non-metallic solid has diffused itself throughout the metal to its great detriment.

It is evident, therefore, that deoxidizers are quite a necessity in the brass-founding business.

The question is, what are the best deoxidizers to use? The answer to this is not easy to give offhand, as there are many things to be taken into consideration, such as the cost and the manner in which the deoxidizer must be applied.

There are some deoxidizers that do more harm than good, if not properly applied, while others add greatly to the

cost of the alloy. The most commonly used deoxidizers are zinc and phosphorus, although zinc is not usually classed as a deoxidizer, as it is generally one of the alloying metals; but for some alloys, notably red brass, zinc is the only deoxidizer that need be used. The advantage of zinc as a deoxidizer is that it can be used with a free hand—a little excess does no harm.

When used purely as a deoxidizer, however, especially in the case of copper, it is a singular fact that zinc is much more efficient when applied as a brass, preferably as a 50-copper 50-zinc alloy, than when added in the metallic state.

Phosphorus is a more powerful deoxidizer than zinc; it is more applicable to the copper-tin alloys, but when present in quantity causes tin-liquation.

For steam metals and copper-tin-zinc-lead alloys, manganese is the best deoxidizer, but must be used with great discretion, as there is little leeway between enough and too much. When used correctly, however, the maximum strength of the treated alloys is attained.

Another element extensively used as a deoxidizer is silicon, but its use is almost entirely confined to copper, because most brasses and bronzes contain lead, and lead and silicon unite to form lead silicate, which makes very drossy castings, so that the remedy is worse than the disease.

It is not always the element that possesses the greatest affinity for oxygen that makes the best deoxidizer for copper and its alloys. Magnesium, calcium, strontium, aluminum, barium and sodium possess the greatest affinity for oxygen, but the only one that is at all promising is barium. Magnesium, even when used skillfully, is no better than phosphorus, if as good. Calcium is out-classed by manganese in the alloys in which it works best, the bronzes such as 88-10-2. Aluminum is out of the question in bronze, as everyone knows, because of the dross it causes.

It is a question whether some of the elements that have a comparatively feeble affinity for oxygen, but, of course, greater than copper, would not be the most promising field for investigation in a search for the ideal deoxidizer for brass and bronze.

Manganese-Bronze from Scrap

By LIEUTENANT J. B. RHODES, U. S. N.

At the Washington Navy Yard the accumulation of a large quantity of miscellaneous non-ferrous scrap has led to the careful study of the metallurgical problems connected with the successful use of such materials. It is proposed to deal in this paper with the production of manganese-bronze ingots alone and to describe the materials used and the foundry practice, so that the experience gained here may be of value to others who are confronted with a similar problem.

quantities, but should be avoided as the lead content is too high.

Of these materials naval brass and cartridge-case metal can be and have been used in the manufacture of cast naval brass, but the demand for cast naval brass has not been great enough to warrant holding scrap for use in that alloy alone, so it has been necessary to work out an economical and practical method for manufacturing manganese-bronze ingots.

The results of experiments during about six months have shown that it is practicable to make high-grade ingots

THE NEW SIZE OF THE BRASS WORLD

Beginning with the January, 1916, issue the BRASS WORLD AND PLATERS' GUIDE will be increased from "magazine" size to standard trade paper size, i.e., 9 x 12 in.

This change has been found necessary on account of the rapid growth of the publication during the past year, and in order to improve our service to both subscribers and advertisers. This means a larger, better illustrated and more attractive looking publication for the reader, while for the advertiser it means an increase in the size of each advertisement of about 75 per cent, which will add greatly to the effectiveness of the display, and also allow of the use of larger as well as a greater number of illustrations.

"Keep your eye on the BRASS WORLD AND PLATERS' GUIDE."

The accumulation consisted chiefly of skimmings, turnings and trimmings, and obsolete or defective castings of compositions so doubtful that it was not considered advisable to use the materials directly in the production of castings. The yellow-metal scrap only is worth considering, although small amounts of red-metal scrap can be used to obtain the necessary tin. The following materials were available with composition approximately as shown:

Naval Brass—Copper, 62 per cent; zinc, 37 per cent; tin, 1 per cent.

Cartridge-case Metal—Copper, 68 per cent; zinc, 31.6 per cent; nickel, 0.4 per cent.

Manganese-bronze — Copper, 59 per cent; zinc, 41 per cent.

Commercial brass can be used in small

in an oil-fired Rockwell furnace of about two tons' capacity. This has been accomplished in spite of the well-known prejudice against open-flame furnaces in the manufacture of non-ferrous alloys. Oxidation has been reduced to a very small amount by using wood scraps from pattern shop, and salt. The bath is protected by the molten salt, and the wood insures a reducing rather than an oxidizing atmosphere in the furnace. The zinc losses are lower than is the case when no covering is used.

Before undertaking the manufacture of manganese-bronze itself a special hardener is made. This hardener is really the secret of the whole process, and although it can be made in any desired proportions, it has been found that the following is most satisfactory: 100 lb. copper, 25 lb. mild steel, 25 lb. (80 per cent) ferro-manganese. The

**Journal Am. Soc. Naval Engineers.*

ferro-manganese and mild steel are melted and the copper (usually copper wire or other scrap) added as fast as the mixture will take it. Pots should be well stirred in the furnace. The alloy is best made using pots containing about 250 lb. each, and pouring these into a ladle for casting. Great care should be taken to skim the pots before pouring into the ladle. The hardener can be cast into ingots in green-sand open molds. After carefully skimming, both in the pot and in the ladle, it will be found that practically all of the carbon has been eliminated, as it separates from the alloy, floats on the top and is removed by the skimming. The resultant alloy will be quite clean and can be readily broken into pieces of any size. The alloy has a characteristic blue-gray color.

This hardener has proved most satisfactory as a means of introducing the desired percentages of iron and manganese. Aluminum and tin are added at the end of the heat, as needed, to make up the desired percentages of these constituents.

In determining the proper amount of scrap for a charge the approximate analysis of scrap on hand must be known. It is necessary to consider the scrap as so many pounds of copper, tin and zinc, and sufficient accuracy will be found if we work out the mixture to contain 57 per cent copper and add aluminum and tin as may be necessary. Suppose there is on hand a stock of scrap condenser tube containing, approximately, 70 per cent copper, 29 per cent zinc and 1 per cent tin. In order to bring the copper content to 57 per cent it will be necessary to use only about 78 lb. of scrap per 100 lb. of manganese-bronze. Zinc is added to reduce the percentage of copper.

The composition desired is as follows: Copper, 57 per cent; zinc, 40 per cent; iron, 1 per cent; manganese, 0.75 per cent; aluminum, 0.75 per cent; tin, 0.50 per cent.

To obtain manganese 0.75 per cent, about 5 lb. of hardener should be used for every 100 lb.; this gives $2\frac{1}{2}$ lb. copper, so that only enough scrap (condenser tube) should be added to bring copper content to 57 per cent., *i. e.*, 54.5 lb. of copper, which will be obtained

from 78 lb. of scrap. This amount of scrap will carry 0.78 per cent tin. In addition to these, one pound of aluminum should be added for every 100 lb. of charge as computed.

We now have 78 lb. condenser tube, 5 lb. hardener, 1 lb. aluminum. To this should be added 16 lb. zinc to bring total to 100 lb. This gives a zinc content of 38 per cent, assuming that there are no losses. About 5 to 8 lb. more should be added to make up for losses, which actually do occur, and the desired composition will finally be obtained.

After analysis of the heat the amount of zinc necessary to bring zinc up to 41 per cent. can be calculated, and this amount should be added when remelting for pouring into castings. The best bronze, showing the highest tensile strength, is a bronze containing 41 per cent zinc. If zinc drops to even 38 per cent, tensile strength is reduced and a soft bronze obtained.

In melting in the oil furnace the most difficult scrap to melt should be charged first, although all but finals may be charged at once. As soon as melted the hardener should be added. In about half an hour charge the remaining scrap (if charge is not made all at same time) and continue the melt. After the heat is well up add zinc, then tin (if necessary) and finally aluminum; stir well and tap. Small ladles are used for pouring the ingots. Ingots are numbered to show the heat and turned into the store awaiting analysis. The cost of the method is high, on account of the labor in pouring and marking ingots, but, counting in furnace loss, labor, fuel and upkeep of furnace it is less than two cents per pound, so that scrap worth $7\frac{1}{2}$ cents per pound can be converted into manganese-bronze to cost not over 10 cents per pound.

One of our heats gave 82,000 lb. tensile strength and 28 per cent elongation. Quite frequently 75,000 lb. tensile strength and 20 per cent elongation are obtained in sand castings. If high pouring temperatures are avoided and the metal is poured when it ceases to give off zinc fumes in large volume, it will be found that excellent values are obtained so long as the zinc content is kept up at or about 41 per cent.

UNIQUE ENGLISH GEAR PATTERN MAKING MACHINE

By FRANK C. PERKINS

A novel and interesting mechanical wood worker is shown in the illustration with the pattern gear, spur wheel and pinion of various types made in a remarkably short time, and with great economy.

This English mechanical woodworker was designed and constructed at Leicester by Wadkin & Co., and is of

It will be noted that the cutter is used in an ordinary slot cutter holder, but as in working all spiral gears, a special gear-cutting fixture is employed as well as a Universal spiral head.

Fig. 2 shows the machine at work on a large spur wheel which was completed in $1\frac{1}{2}$ hr. This spur wheel has a 7-in.

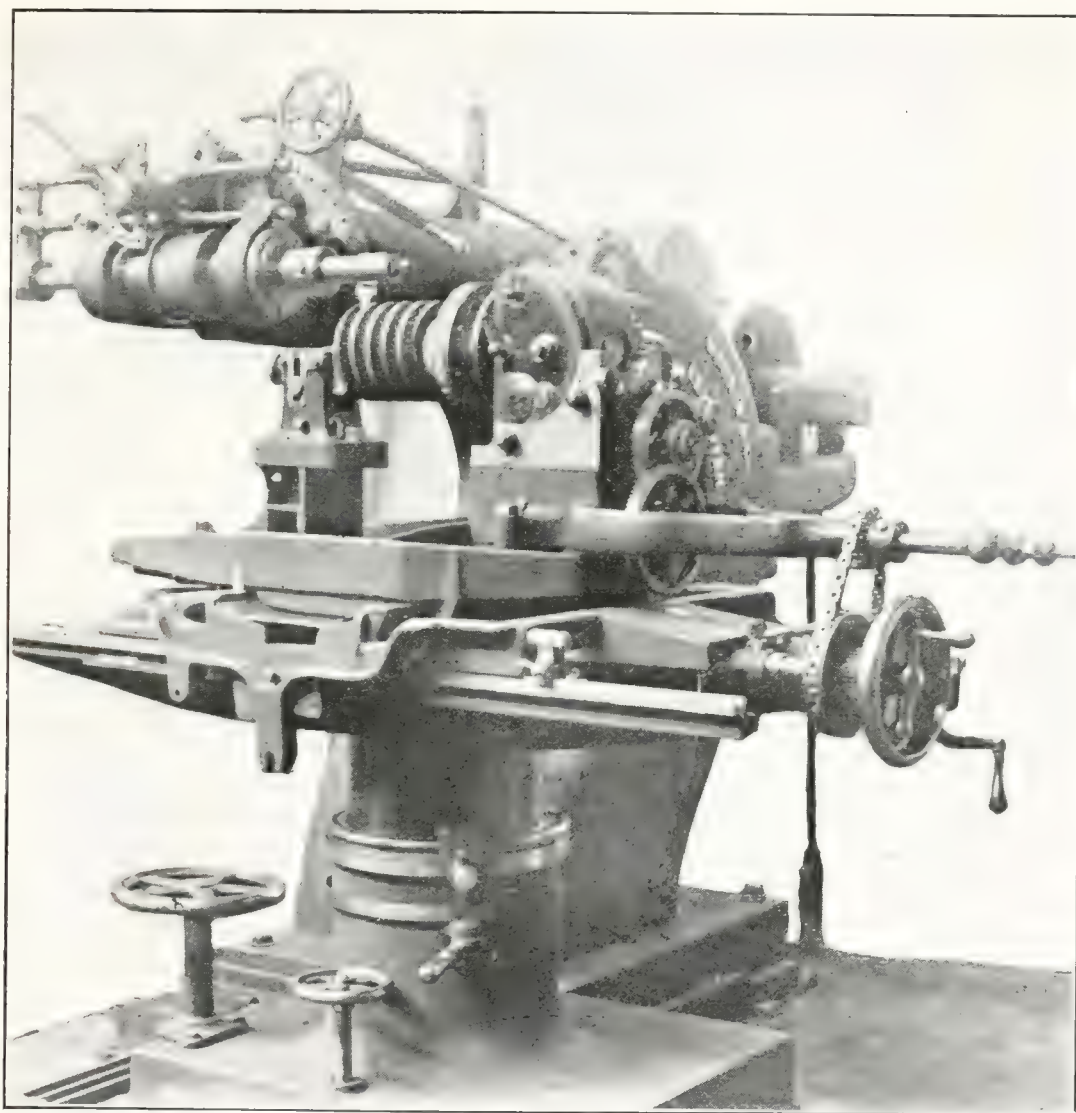


Fig. 1

special value for pattern and core box work, being in reality a universal milling machine applied to wood work.

Fig. 1 shows the machine operating on a screw which was cut complete in nine minutes. This worm pattern is 9 in. long and 6 in. in diameter. The cut was stationed by a simple flat flycutter which was made in a very few minutes.

space and 81 ft., the diameter being $38\frac{3}{4}$ in. A simple flat inexpensive fly cutter only was used in one of the cutter holders, no special attachment being required, a dividing head only being necessary for operation.

It will be noted in the illustrations that this new English mechanical woodworker is of strong rigid pattern with

solid cored frames. The main frame is a solid cored casting, and the rocking head, or overhanging arm, carries the spindle head and rocks vertically on sensitive bearings and can be depressed to a low angle below the level of the table.

From the vertical to a horizontal position the spindle head swivels the cutter spindle, having a reversing motion, and

foundation frame on runners actuated by a hand wheel. It can instantly be moved across the front of the machine from under the cutter spindle and away sideways, clear altogether of the machine head, in which latter position the spindle head can be lowered under the level of the table top.

Besides the lateral movement of the table body the table is provided with a

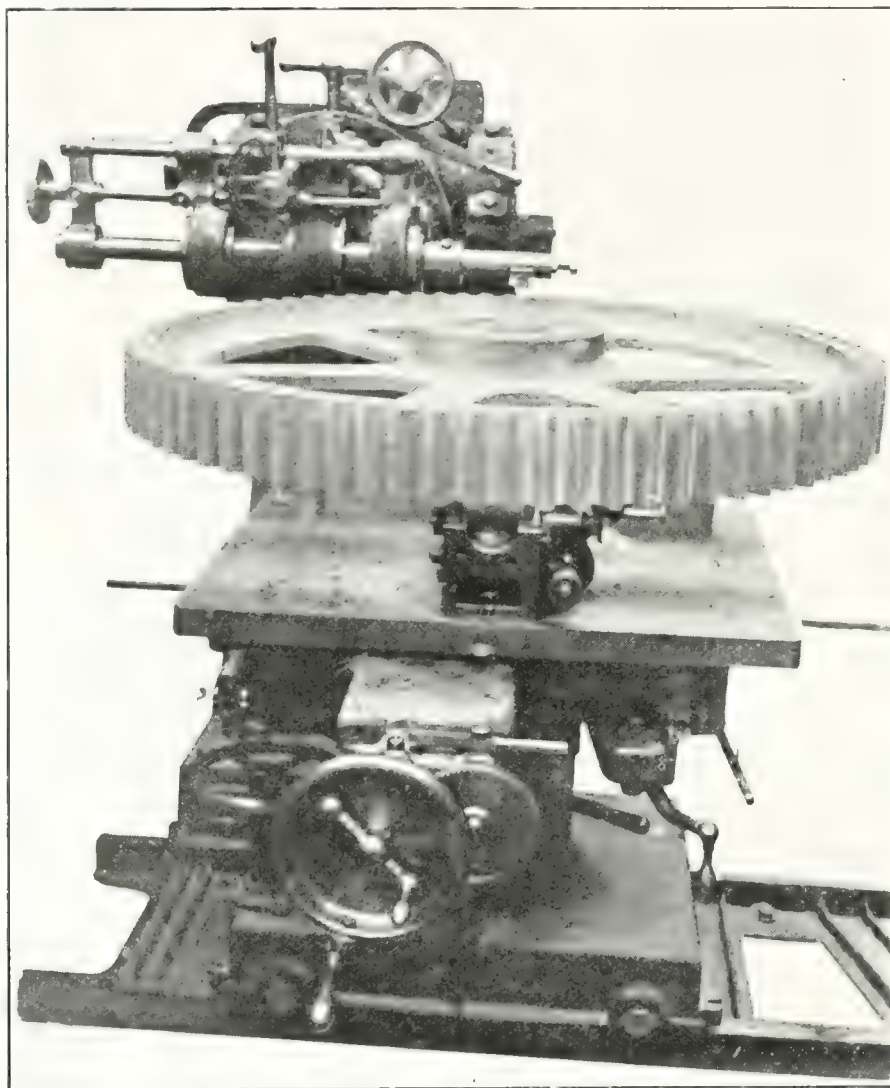


Fig. 2—Large Spur Wheel Completed in One and One-Half Hours

it can be worked in any regular position between the vertical and horizontal. In addition, the cutter spindle is free to slide independently of any movement; and a slow screw adjustment. A registering scale is fitted to this slide adjustment giving the depth of cut. The swiveling motion is also provided with graduated scale for instantly setting to any desired adjustment, giving the depth of cut or any angle of cut.

The table mounting is a heavy cored casting free to move bodily upon its

longitudinal and cross motion, and is moved upon a sensitive ball race actuated quickly either by hand or by positive screw and rack motion. It can also be raised and lowered and will turn through a complete circle horizontally. It can be moved around to work lengthways or at an angle at will.

It will be noted that the striking gear is actuated from either side of the machine head and the turning of the table and swiveling of the head can be instantly effected. The work need only be

roughly set and the fine adjustment can afterward be readily got by screw, effecting a great saving of time in setting. The motion on the spindle can be reversed when working in any angular position. The spindle is of forged tough steel and is provided with a boss at one end bored up to take Morse tang cutter holders, slot mortising bits and the like. It has a hardened face, soft center, and a loose spindle is fitted to take ordinary molding cutter blocks, tending head saws and disc cutter head. The cutter spindle runs in special double race ball bearings, the cones of which are

It is employed to advantage in boring and slotting large-size holes at any angle and facing, cutting port holes, sinking and molding straight or curved arms of wheels, and shaping the bosses.

It may also be utilized for recessing and trenching and gear cutting, plain, spiral or bevel, as well as boring up to 6 in. in diameter or any larger size by rioting the work table.

It is especially valuable for square mortising, shaping square and tenoning any length and width, double or single, and scribing at one operation, as well as dovetailing right and left-hand sets at

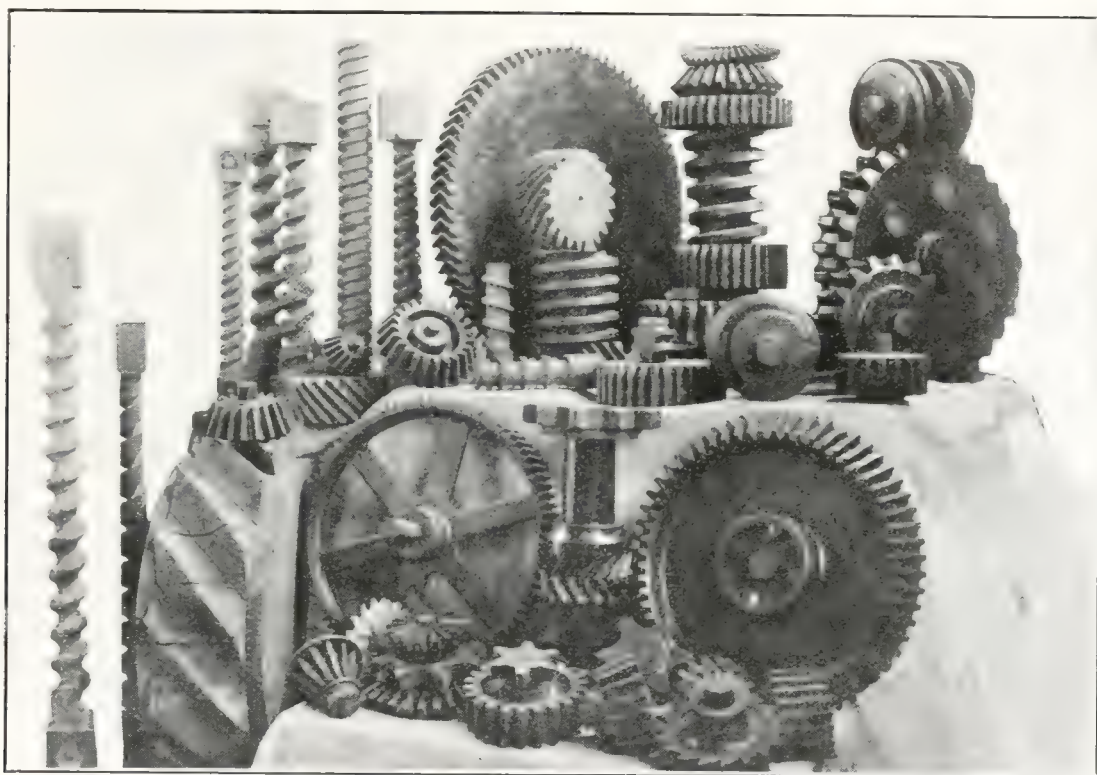


Fig. 3—This Group of Gears, etc., Represents About Two Days' Work on the Machine

ground to fit the spindle in such a manner that the spindle itself receives little or no wear.

Some of the important operations in pattern work, also joinery and cabinet work, to which this machine is readily applied, includes the making of core boxes, square bends, tees, socket ends, valve boxes and pump boxes, as well as regular and irregular patterns to match. It is also used for cross grooving, trenching, halving, jointing, as well as recessing and routing out heavy bodies, rounding curves; also shaping U. D. & C. shaped sections, and turning up sectional built-up pieces direct from the saw.

no setting; also spiral and ornamental work of any geometrical design.

Volume is the root of all evil in the business of to-day. If you ask a man about his business he will reply that he did more business yesterday than he did on the corresponding day a year ago; or, more business last month than the same month last year; or possibly he has enjoyed the biggest year in his business career. It is all we know and all we talk. We buy for volume, pay extra rent, keep extra help, pay heavier taxes and insurance, all for volume, and incidentally pay our bills if we can. We are anxious to do so much more business regardless of our net profit.

The Corrosion of Galvanizing Pots

The conditions which affect the durability of the iron sheets that are used as galvanizing pots have up to the present not been closely investigated. In the *Journal* of the Association of German Engineers Herr C. Diegel reports a series of experiments made for this purpose on various iron sheets. The sheets, which were of various composition, were analyzed, metallographically tested, and divided up into a number of samples. These were then hung up in hot galvanizing baths of various temperatures for eight hours, the same degree of heat being, if possible, maintained. The loss of weight which took place per unit of surface during one hour proved the solubility of the iron in heated zinc at various temperatures. The following conclusions were reached:

1. Irregular texture increases the solubility.
2. A high percentage of carbon in the iron does not increase the solubility; in a superheated bath the carbon reduces the solubility to a not inconsiderable degree.
3. The difference of 0.025 to 0.009 per cent in the phosphorus-content of the iron is hardly noticeable in the solubility of the iron at the usual temperatures of the galvanizing bath. In the superheated galvanizing bath the higher phosphorus-content, however, has a very unfavorable effect.
4. The effect of a higher or lower percentage of manganese on the solubility of the iron is not apparent.
5. A higher silicon-content, however, seems considerably to increase the solubility.

Of more importance than these results was the observation made during the experiments that the temperature of the bath is of great influence on the solubility of iron in zinc. This influence far exceeds all other circumstances, and explains the results obtained in practice where the walls of new pots which have only been used for a short time become corroded through and through. It was established by the experiments that the solubility of the iron in hot zinc grows with the increasing temperature of the galvanizing bath, until about 500 deg. C. has been reached. At this temperature a gradual increase in the solubility sets in which is followed by a

further considerable increase if the bath is heated still more. The weight of iron dissolved in a given time may be about nine times as great as a temperature of about 500 deg. and more than thirty times as great at 530 deg., than at a temperature below 490 deg. A continuous temperature of 500 deg. and more of the galvanizing bath must therefore lead to a rapid destruction of the pot.—The Ironmonger.

Metallurgical News

First the report of the starting of the new system of metallurgy at Anaconda, with strong promise that the total extraction of copper is to be raised to some figure above 90 per cent (instead of about 78 per cent, at present); the inauguration of operations at Chuquicamata, and the news that the American Smelting & Refining Co. is going into the tin-smelting business. Of no less importance are the announcements that the Anaconda Copper Mining Co. is developing a copper mine in Chile and is contemplating acquiring interests in tin mining in Bolivia; and the official statement that the U. S. Steel Corporation is going to build an immense zinc smelter near Pittsburgh.

A large number of English engineers share in the advantages of an agreement arrived at at a conference of representatives of the Engineering Employers' Association and the Amalgamated Society of Engineers, the Steam Engine Makers Society. This gives the work people an advance of 3s. on time rates and 7½ per cent on piece rates, in lieu of smaller war bonuses now being paid.

The output of Spanish antimony, according to Consul General Carl B. Hurst of Barcelona, Spain, could be multiplied greatly, as only a few of the many antimony mines in the Barcelona district are fully exploited. There is but one antimony smelting plant there, the output of which is insufficient to meet orders from the United States.

The mine production of silver in California in 1914 was 1,471,859 fine ounces, valued at \$813,938. Of this 1,436,982 oz. was won by deep mining. The larger part of the output, 1,267,752 oz., valued at \$701,067, was derived from crude smelting ore.

Restoring "Dirty" Metals

Not infrequently when metal is melted it will be found that from overheating or some other cause it becomes dirty, and in that state it is of small use for casting purposes. If clean metal is melted to its pouring temperature only and poured at once, there should be no dirt in the metal and very little on the surface, but if it becomes overheated, or is kept standing in the molten state for any length of time, it gets full of oxide and becomes stiff and unfit for pouring. In that condition sound castings cannot be made, and even with lead in run joints the metal is unsafe if it has to withstand any pressure. For such metal there are only two ways of disposal, either the stuff must be sold as low-grade scrap or it must be made clean.

Assuming that it is worth cleaning, it is a good plan to run it into inch-square bars in sand molds, and these should be broken into about 2-in. lengths for remelting, which can then be done without undue waste. If soft metals are being dealt with in iron melting-pots, the pots should be thoroughly cleansed and coated with a wash of plumbago and water, which ought to be rubbed to a polish when the coating is dry. A handful of plaster of paris, dry ground chalk, or some similar material, and a little crushed charcoal should be placed in the bottom of the pot, and on this the metal should be placed. The melting should be done without overheating, and the cleansed metal poured into bars or ingots from under the fluxing layer. With very bad metals it may be desirable to skim off the plaster as soon as the metal is melted, and then stir in a small quantity of dry zinc chloride with a piece of wood, using 2 oz. of chloride to 100 lb. of metal. This effectually cleans the metal and makes it usable, though the result is improved by adding some new metal to it. Tin alone can be best cleaned by well stirring with a piece of wood well smeared with tallow, which will remove all occluded oxide.

With bearing metals the use of plaster, chalk, or granulated charcoal should be sufficient if placed under the metal in the melting-pot. Usually, however, where these alloys have been overheated the antimony content is reduced or practically removed, and some amount of fresh metal may have to be added. With old metal careful skim-

ming is necessary, as iron and other hard substances which float off are likely to be present. Such skimming may have to be done more than once.

If overheated or allowed to stand in a molten state aluminum and aluminum alloys suffer, and the resulting castings will be faulty. To restore this metal it should be heated to a wine-red only, and while in that condition a dose of from 1 to 4 oz. of dry zinc chloride should be stirred in with a wooden rod, after which the metal should be allowed two or three minutes to become steady, and then be either poured into ingots or castings. In some cases the addition of from 1 to 2 per cent of new zinc is an advantage, but that remedy must depend on the purpose for which the metal is to be used.

Where iron is known to be present in brass scrap it should be removed by passing it through a magnetic separator, but even then, as soon as the brass is melted, the surface should be skimmed for the iron likely still to be present. About 2 oz. of zinc chloride in a dried state well stirred into the molten metal will clean it if it has not been burned, while an ounce or two of 5 per cent phosphor-tin put into brass makes it cast better, assuming that mixed scrap is being used. Burnt and otherwise dirty metal holding dirt in its mass would be best treated by plaster of paris as previously described, after which a little new zinc should be added. Gunmetal may be treated in much the same way as brass, except that a little 5 per cent phosphor-tin would be added instead of zinc. It is well to point out that the strength of gunmetal and brass is reduced when overheated and in a dirty state, for which reason remelted metal should be used sparingly, and in small quantities with new mixtures when strength is required in the castings.—The Ironmonger, London.

Ample and properly located windows, even though kept reasonably clean, will not alone solve the problem of effective shop lighting. Much of the light will be wasted if it strikes dark walls, posts or ceilings which absorb a great deal of light; whereas, if they were white or light in color they would reflect the light in diffused form. In this particular also the foundry presents greater difficulty than other workshops.

New Primary Battery

*H. Bellini—Bulletin de la Société Internationale des Electriciens.**

A well known deficiency of electric cells consists in the tendency of the solution to form a salt of the metal composing the soluble electrode. This is the case in the ordinary copper-zinc cell; the sulphuric acid combines with the zinc to form a zinc sulphate and the tendency of the current then is to decompose the sulphate and deposit zinc on the copper. This zinc on the copper constitutes a galvanic couple which tends to dissolve the zinc again and to restore the copper to its original state. Thus two contrary actions take place, one tending to deposit zinc on copper, the other tending to dissolve this deposit.

To eliminate the difficulty it is necessary to prevent the zinc deposition. In two-liquid cells, like the Daniell and Bunsen, this is effected by retaining the zinc salt around the zinc electrode. The author has obtained a similar result with a single-liquid cell, which has the advantage of offering lower internal resistance than do the two-liquid cells, inasmuch as the electrodes can be placed close to one another and intermingled just as in storage batteries, where a number of pairs of plates are alternated.

The evident means of accomplishing this consists in employing electrodes which form insoluble salts, and lead, of course, is first thought of for this purpose. A difficulty, however, lies in the fact that both the sulphate and the chloride of lead stick to the lead surface and increase internal resistance beyond permissible limits. A partial solution of this difficulty consists in adding nitric acid to the sulphuric or hydrochloric, but the complete solution was found in the employment of an amalgam of lead instead of the lead alone. Using this, the insoluble salt which is formed falls automatically to the bottom of the jar.

Although the solution used may vary within certain limits, sulphuric acid is found preferable to hydrochloric, and a good formula consists of 1000 parts of water, 80 parts of sulphuric acid of 66 deg. Beaumé, and 120 parts of nitric acid of 36 deg. Beaumé. An increase in

the proportion of sulphuric acid increases the voltage developed but also increases the internal resistance, making it sometimes difficult to start the cell. An increase in the nitric acid decreases both the voltage and the internal resistance; while an excessive quantity of nitric polarizes the cell by forming a deposit of zinc.

The optimum for the lead amalgam is nine parts of lead to one part of mercury. To avoid volatilizing the latter, the lead is first melted and the mercury is added just before pouring into the molds. The other electrode should consist of some material insoluble in acid, preferably carbon.

The voltage developed will vary from 1.10 to 1.15. The internal resistance, as in the case of all cells, varies with the current furnished. In this case it was found that an increase in resistance chiefly depends on the thickness of the lead sulphate coating which adheres to the plate before falling. In a certain small cell tested the internal resistance showed a maximum of about 0.13 ohms. In this case the lead-amalgam plate had 31 sq. in. of surface exposed and was placed between two plates of carbon at an average distance of about $\frac{3}{4}$ in. from each, the total surface of the carbon plates being $35\frac{1}{2}$ sq. in. The lead-amalgam plate was in the form of a wedge with the small end down. A shower of heavy white powder fell from it and was found to consist of lead sulphate, metallic mercury, and a little sulphate of mercury.

The carbon electrode developed a certain amount of nitrogen. So little of this was collected as to make the nature of the reaction involved uncertain, but it was found to consist of about 92 per cent nitrogen, with some nitrogen oxides, carbonic acid, oxygen, hydrogen, etc.

With the circuit open, the consumption of lead amalgam is very small. The electromotive force of the cell increases slightly during the first moments of operation and then decreases uniformly at the same rate that the electrolyte is used up; the curve of discharge resembles that from a storage battery. Experiments with the cells with prolonged discharge, periods of rest, and renewed discharge, show that by adding new elec-

*Abstract by *Engineering Magazine*.

trolyte and cleaning out the deposit of salt, action can be maintained as long as the lead amalgam holds out. The consumption of lead amalgam is about five grams per ampere-hour. The figures obtained by the author were confirmed pretty closely by the Société pour Le Travail Électriques des Métaux.

The cell is held by the author to possess advantages over other sources of current in certain cases, such as use in wireless-telegraphy field stations, in small electroplating installations, and in laboratory work.

To Separate Silver from Platinum Waste

The entire waste is cut into small pieces and heated to redness (to destroy grease and organic substances) and then dissolved in *aqua regia* (3 parts hydrochloric acid, 1 part nitric acid). The platinum and all metals combined with it are thus dissolved, but the silver, as chloride, in the form of a gray, spongy powder, is deposited. The solution is then drawn off, tested for the possible presence of gold, which by means of oxalic acid is precipitated as a fine, yellowish powder. The other metals remain unaffected. The platinum still present in the solution is recovered by gradual addition of salammoniac, as a yellowish gray powder. These different precipitates are washed out with warm water, dried, and with the aid of suitable fluxes transformed into the metallic condition.

Platinum precipitates must, however, first be purified, and for this purpose must be first heated to redness. Then any steel or iron fragments present are extracted by means of a reagent, the remainder immersed in concentrated sulphuric acid and heated with it as long as any action of the sulphuric acid is noticeable. The remaining powder is then pure platinum.

Hot sulphuric acid dissolves silver without affecting the platinum. The fluid employed for the separation of the platinum is then diluted with an equal quantity of water and the silver precipitated therefrom by means of saturated solution of common salt, the salt solution being slowly added until no more separation is apparent. The fluid is then care-

fully drawn off (filtered off), the residue washed out in warm water, dried and with some soda to act as a flux, is melted down into pure silver.—Manufacturing Jeweler.

Aluminum Bronze for Munitions

The high price of spelter has made the use of a substitute highly desirable in the manufacture of brass for munitions of war and other purposes. Professor Carpenter has recently called attention to the fact that the copper-aluminum bronzes are for many purposes even more suitable than the usual copper-zinc brass. Hitherto their cost has made their use prohibitive, but now the position is reversed, and they are cheaper to manufacture than brass. Most brasses need 30 to 40 per cent of zinc, while the aluminum bronzes need only from 7 to 10 per cent of aluminum to give properties of the same general character. The founding of these alloys, however, presents difficulties different from those associated with the casting of brasses, difficulties which center around the tenacious film of alumina which is formed on the surface of the molten alloys, and which have to be overcome before satisfactory castings can be produced. The eighth report to the Alloys Research Committee of the Institution of Mechanical Engineers, on "The Properties of Alloys of Aluminum and Copper," by Professors Edwards and Carpenter, published in the *Proceedings of the Institution*, January, 1907, pages 57 to 378, contains very full information as to the casting, working, heat treatment, and mechanical properties of these alloys. A later paper on "The Production of Castings to Withstand High Pressures," in the proceedings of the same institution, December, 1910, pages 1597 to 1660, deals particularly with the difficulties encountered in the founding of these alloys. Both publications contain, in the discussion and communications, contributions by practical men.—The Ironmonger.

We have always subscribed for the BRASS WORLD and have found it to be a great benefit to us.—Philadelphia Silver-smithing Company.

Test for Spelter Castings

It has been customary to express the weight of coating on wire in pounds per mile, while on sheet products ounces per square foot is the rule. This was the opening statement of the paper read by J. A. Aupperle, metallurgical engineer, before the American Society for Testing Materials.

If the results are expressed in ounces per square foot of surface on both wire and sheets, there will be a better understanding as to the thickness of coating on the respective products. In stating the weight of coating on galvanized sheets it is customary to express the weight based on one surface only, that is, a sheet containing 2 oz. of coating per square foot really contains 1 oz. on each side of the sheet.

It is proposed to express the weight of coating on wire in ounces per square foot, and also to use such lengths of wire that the number of grams of coating found will be equivalent to ounces per square foot, without calculation. These lengths must be such that the surface coated is equal to 5.079 sq. in. It is likewise proposed that the samples for determining the weight of coating on galvanized sheets shall be $2\frac{1}{4} \times 2\frac{1}{4}$ in. (area = 5.079 sq. in.). The number of grams of coating on a section of this size will also express the weight of coating in ounces per square foot without calculation.

The method for determining the weight of spelter coating consists of using a small amount of antimony chloride in hydrochloric acid (sp. gr. 1.20). Antimony chloride appears to hasten the solution of the coating, and after the coating has dissolved a thin film of antimony plates on the surface of the base metal and retards the solution of iron or steel. Experiments have shown that sheet steel $2\frac{1}{4} \times 2\frac{1}{4}$ in., which loses 50 mg. in five minutes in cold hydrochloric acid (sp. gr. 1.20), will lose in that time only 1 mg. in the same acid containing 80 mg. of antimony per 105 c.c. of acid.

In the proposed method the metal is immersed in the acid only one minute, which is long enough to dissolve several grams of coating, yet the amount of iron or steel dissolved is negligible. The small amount of antimony that plates on the surface of the sample can easily be removed by scrubbing under running water. This method is one of the most rapid and accurate, and a determination can be made in less time than is occupied in making the Preece test.

For determining the weight of coating on galvanized sheets cut several samples $2\frac{1}{4} \times 2\frac{1}{4}$ in. from various parts of the sheet. These samples, about five in number, should be weighed together and immersed singly for 1 min. in 100 c.c. of hydrochloric acid (sp. gr. 1.20), to which has been added 5 c.c. of antimony chloride prepared by dissolving 20 g. of antimony trioxide in 1000 c.c. of hydrochloric acid (sp. gr. 1.20). The same 100 c.c. of hydrochloric acid can be used for at least five samples. Five cubic centimeters of the antimony chloride, however, should be added for each sample on account of the antimony being removed from the solution by the iron.

The samples are washed and scrubbed under running water, dried with a towel, and laid in a warm place for a few seconds. The samples are again weighed together and the number of grams lost is divided by the number of samples taken. Each gram corresponds to 1 oz. of coating per square foot.

To determine spelter coating of wire, a small section of the galvanized wire should be stripped in hydrochloric acid containing antimony chloride. The diameter of the black wire should then be carefully measured in order to determine the length of wire, such that the number of grams of coating will represent the number of ounces per square foot of surface. [These lengths are given in a table in the paper.]

The method of making the test is very similar to that outlined for galvanized sheets, except that the wire is first cleaned with carbon tetrachloride or gasoline, and after being carefully weighed is placed in a tall glass cylinder containing hydrochloric acid (sp. gr. 1.20), to which has been added from 2 to 3 c.c. of antimony-chloride solution of the same strength as used on galvanized sheets. The reason for using one-half the amount of antimony chloride in the case of wire is on account of taking one-half the area. As previously stated, the coating on galvanized sheets is expressed in ounces per square foot, considering one side only, when in reality this amount of coating represents 2 sq. ft. of surface. After immersing the entire length of wire for 1 min. it will be found convenient to pour the acid solution into another tall cylinder in order to facilitate removing the wire. The wire is then scrubbed under running water, wiped, thoroughly dried in a warm place for a few

seconds and again weighed. Each gram lost corresponds to 1 oz. of coating per square foot. For direct comparison with the weight of coating as expressed on galvanized sheets, this figure should be doubled. Abstract of paper given by *Iron Age*.

Nickel

Mr. H. C. H. Carpenter has an article in *Nature* on the use of nickel in the making of munitions of war, in which he says that nickel is an indispensable constituent of gun and armor-plate steel and of the modern bullet and armor-piercing projectiles. In all these instances its action is specific, and it is doubtful whether any satisfactory substitute is known. It is therefore a munition of the highest importance. The world's production of nickel is not very great. In 1912 it was 26,000 metric tons. It is, therefore, of interest to know how much of this is in British hands and how much in that of the enemy. Of all the nickel in the world in 1912, he says: "Canadian mines and smelters produced 85 per cent in the form of a copper nickel matte (sulphide), 89 per cent of which was refined in the United States, and the rest at Clydach, in South Wales, with the production of the pure metals. New Caledonia supplied almost all the remaining ore required, this being shipped to Europe and smelted there. So far as Canada is concerned the situation is dominated by two companies, the International Nickel Company and the Mond Nickel Company; while the production of nickel ore in New Caledonia is monopolized by two large French companies. The only nickel ores situated in the enemy countries are Kupfer Nickel Cloathite and Nickel Glance." It should be explained that Kupfer nickel gave the original name to the metal under discussion. Kupfer nickel looks so exactly like copper (kupfer) ore that attempts were made to get the copper out of it. It has no copper in its composition, so it was supposed to be bewitched, and the gentleman known as "Old Nick" was credited with the bewitchment. So nickel is the devil's metal.

"Mil."

The use of the words cubic centimeter is really an error, and the United States Government, through its bureau of standards (see Bulletin No. 47, page 12), has declared cubic centimeter a misnomer.

Very careful experiments by the Government physicists have determined the fact that the cubic centimeter is larger than the milliliter by the inconsiderable fraction of 0.000027. In chemistry, and in applied chemistry this difference is negligible, but everyone must have regretted the cubic centimeter blot on the harmony and simplicity of the metric system. The unabridged word cubic centimeter is too long for every-day use by the chemists of the world.

In actual practice it will be noticed that at chemists' congresses and conventions nearly everyone reads c.c. as "See-sees." These are some of the results following the original error of adopting such a word as cubic centimeter officially. In the government tables ml is used, but ml is difficult to pronounce, hence an abbreviation can just as well take in a vowel—the i, and so we have the first syllable of three letters of the word milliliter. Now mil can be used with a period, indicating that it is an abbreviation, but it is much better to adopt the word mil, as it will be called, and do away with the period. This will also permit the use of the plural mils. If the period is retained, it would be awkward and improper to use the plural as mil.s.

We have only to remember never to say cubic centimeter or use the abbreviation c.c. again. The change is only a change of name. It does not involve any calculations or changes in formulae. Cross out c.c. and write mil.—Druggists' Circular.

The Prospect for Copper

The hopes for a rally in copper that were recently entertained failed to be realized and the price has declined further. It appears that the buying for ammunition in June, and earlier, was much in excess of the immediate requirement, and although further contracts have probably to be made the buyers are more cautious, slower to act, than they were. In the meanwhile production has increased to about the limit of present refinery capacity. Domestic consumption has failed to increase materially. Although the producers have already contracted to deliver a good deal of the copper that they expect to produce for a long while ahead, even in 1916, there remains a large supply of current production to be sold, and the excess of supply over demand is having the natural effect.

Reclamation of Magnalium from Turnings

JOHN COULSON.*

The use of magnalium metal for finished castings has increased to such an extent that the recovery of the metal from the turnings has become an important factor. This paper is a short account of an investigation of the problem, and outlines successful means of acquiring very reliable metal from the turnings, without suffering more than one or two per cent loss in the melting.

It is well known, of course, that magnalium metal is an alloy of aluminum and magnesium, having a specific gravity less than that of pure aluminum. Magnalium containing from 5 to 10 per cent of magnesium has very desirable physical characteristics, and castings made from it can be machined without difficulty. The extensive use of this metal, by the Westinghouse Company, in the manufacture of automobile parts, and electrical apparatus brought about the problem of recovering the metal from the great quantity of turnings resulting from the finished castings. Ordinary methods of melting down scrap metal could not be applied in the case of magnalium, on account of the rapidity with which the turnings oxidized. Therefore, a systematic study of the problem was taken up, and the results of this work, which was completed December, 1914, are perhaps of sufficient interest to warrant citation.

Oxidation of finely divided magnalium progresses more rapidly and violently than in the case of aluminum, and it is well known that freshly cut aluminum is covered with an oxide film immediately on exposure to the air. The temperature of a twisted mass of bare aluminum wire can be raised above the melting point without becoming diffused, the wire may sag, but when cooled will be found intact. The jacket of Al_2O_3 prevents the wire from melting into a solid molten mass, and becomes even stronger under comparatively high temperatures. Therefore some process of agitating the melted material must be applied, in order to break up the oxide films, thus

forcing the molten material to diffuse. Fluxes composed of chlorides and fluorides of the alkaline earths have been used with some success. Such fluxes when hot dissolve a certain amount of the oxide, and their gasing throws about the globules of molten metal, inviting them to coalesce. The use of cryolite in the reduction of aluminum has long been known and is quite commonly used for smothering aluminum chips, the cryolite being first melted into a viscous state, then the scrap aluminum fed into the crucible and pushed under the surface of the flux, thus forming a protective layer of cryolite on top, which prevents the chips from further oxidation. The foundry has used this method for some time in melting magnalium turnings, and the recovery for clean material varied from 60 to 90 per cent. Usually, equal weights of cryolite and turnings were added to the melting pot.

The use of cryolite as a flux is objectionable, however, since it attacks silicon or graphite crucibles vigorously, and iron pots cannot be used when pure metal is required. The desirability to avoid using it as a flux led to extensive experiments to find if it was possible to melt the turnings, without appreciable loss, in the presence of some inert or reducing gas. As the work progressed, small, special, air-tight, cylindrical shells were built according as the method of applying the gas demanded. The cavity inside the shell admitted a Gooch crucible which held the charges of turnings to be melted. Tight-fitting caps, pierced with gas pipes, closed the ends of the cylinder. The whole fitted inside an electric furnace, which had a limiting temperature of 1200 deg. C. With everything in place, and after the gas had been washing out the system for five or ten minutes, the electric current was turned on and the temperature raised to 900 deg. C. Of the numerous gases used throughout the work, hydrogen gave the best results. Tests were made to see if forcing the gas through the charge as in the Bessemer Process, would break up and diffuse the molten globules, but the results were inferior to those in the case where the gas was admitted through the pipe overhead. With the downward flow the loss was about 10 per cent. The

*Paper presented at the Annual Meeting of the American Institute of Metals, Atlantic City, 1915.

loss always appeared in the form of fine white powder, and on examination of this residue it was found that nitrides were formed. A strong odor of ammonia was given off when the residue came in contact with water. The vigorous evolution of this gas indicated that nitrogen was occluded in some way, and most likely in the pores of the turnings, since great care had been taken to free the hydrogen used of all contamination.

The next step was to free the turnings of all foreign matter and occluded air, replacing it by some inoffensive fluxing agent, and common salt NaCl served this purpose very well, as will be seen. The turnings were boiled for a few minutes in a 4 per cent salt solution, this was poured off, taking with it the objectionable scum which would otherwise cohere to the turnings if they were scooped out. Further experiments were tried, using the apparatus described above, and charges of the turnings, still moist with the salt solution, but the results were not as good as we had expected. In every case a small amount of turnings remained intact and on top of the metal which had united. A new apparatus was constructed such that gas pressure from above forced the melted turnings through holes in the bottom of the crucible and into a receptacle underneath. In this way it was possible to recover about 92 per cent of the charge, but to use this method on a large scale appears difficult.

It was thought possible to melt the turnings in an open crucible after they had been boiled in a solution of slightly fluxing salt; experiment proved this method to be a success. The turnings, after being washed thoroughly in benzine, were boiled in a salt solution which was poured off just before feeding them into the crucible. The crucible fitted snugly through a hole in the cover of an ordinary blast furnace and before starting operation it was heated to a temperature of 900 deg. C. The damp turnings were then fed into the hot crucible and by mechanical means forced to coalesce as they melted. Each addition of turnings was thoroughly puddled until the mass again became uniformly viscous. Melts from 1 to 6 lb.

were handled in this manner, using different salts and combinations of salts for the bath. A 4 per cent solution of NaCl gave very good results; the recovery being 96.2 per cent.

The application of this puddling process in melting the turnings in the open crucible without preliminary treatment in the salt solution also proved satisfactory. To start the melt a small pellet of magnalium was first reduced to a molten state in the bottom of the crucible, this permitted puddling to proceed on the first application of the turnings, thus smothering them immediately. The average loss from a number of melts, about six pounds each, was 6 per cent.

It was found desirable to let the charge stand in the hot crucible for ten or fifteen minutes, after the last puddling operation. This gave the oxide time to rise to the surface, where it was held while the clean metal was poured from underneath. The dross-like mass that remained in the crucible, after pouring, contained some good metal, but this was separated from the oxide by adding a small quantity of CaCl_2 and stirring the whole vigorously. If the metal began to burn, as will be the case if the temperature gets much above 800 deg. C., a little cryolite (powdered) stopped the action. Drawing the charge off through a hole in the bottom of the crucible, in place of pouring from the top, alleviated the danger of the charge burning up, and permitted the work to go on without having to displace the crucible.

The metal recovered from the turnings can hardly be expected to be as good as the original magnalium. It is practically impossible to avoid the entanglement of some oxide in the melting. However, the physical characteristics of the reclaimed metal can be much improved, if not restored completely, by treatment or the introduction of a deoxidizing agent. Test pieces were poured from melts of new and reclaimed metal, which experienced different treatment, or had added to them a small quantity of deoxidizing metal. The results of the physical characteristics of a few of these pieces are tabulated, and show what may be expected from the various combinations and treatment of the metal. As will be noticed, the magnalium made

in the laboratory, and indicated by the first set of results, is much superior to the shop metal from which the turnings come. Therefore, the characteristics of the reclaimed metal from the turnings are not likely to excel those of the original magnalium.

From the foregoing it is evident that a simple process has been developed for melting down magnalium turnings without heavy loss, or the aid of cryolite; and also possible means of improving the quality of the metal thus obtained.

from a 200-lb. charge being about 1 per cent. Here the recovered metal is poured in the form of large pellets, and later treated before making it into castings. From examination of the tables of physical tests it will be seen that the introduction of a deoxidizing agent brings the old metal up to that of the original shop material. The addition of 1 per cent of metallic calcium or $\frac{1}{2}$ per cent of calcium aluminum silicide is quite sufficient to restore the reclaimed metal to its original physical state.

MAGNALIUM PHYSICAL TESTS

New Material.

History of Pieces	United Stress, Lbs. per Square Inch	Yield Point, Lbs. per Square Inch	Elastic Limit, Lbs. per Square Inch	Per Cent Elong. in 2 In.	Per Cent Reduction
Lab. 95 per cent, Al. 5 per cent Mg.	24,500	11,000	6,000	9.2	13.4
Lab. 95 per cent.	23,100	11,000	5,000	8.7	11.5
Shop 95 per cent.	21,700	19,800	11,200	1.8	1.6
Shop 95 per cent.	24,550	16,250	11,500	4.0	3.9
Shop 95 per cent.	19,630	17,000	9,700	2.3	1.6
Lab. Al.	13,150	7,500	4,000	33.0	52.0

Reclaimed Turnings, Fluxed or Washed with Hydrogen on Second Melting.

History of Pieces	United Stress, Lbs. per Square Inch	Yield Point, Lbs. per Square Inch	Elastic Limit, Lbs. per Square Inch	Per Cent Elong. in 2 In.	Per Cent Reduction
Lab. No. flux.	12,100	11,000	600	0	0
Lab. No. flux.	13,750	13,750	10,000	0	0
Lab. Hydrogen wash.	13,870	13,800	7,200	0	0
Lab. Under cryolite.	20,100	17,500	10,750	0	0
Lab. Under cryolite.	11,950	11,950	9,500	0	0
Lab. No flux, 45 minutes wait.	19,300	15,250	800	1.5	3.5
Shop. Under Cryolite.	15,000	13,000	12,500	0	0
Shop. Under Cryolite.	14,500	12,500	12,500	0	0
Shop. Under Cryolite.	21,750	21,750	16,500	0	0
Shop. Under Cryolite.	19,500	19,500	14,500	0	0
Shop. Under Cryolite.	13,750	13,750	10,000	0	0
Shop. Under Cryolite.	13,900	13,500	7,200	0	0

Reclaimed Turnings Deoxidized on Second Melting.

History of Pieces	United Stress, Lbs. per Square Inch	Yield Point, Lbs. per Square Inch	Elastic Limit, Lbs. per Square Inch	Per Cent Elong. in 2 In.	Per Cent Reduction
Lab. $\frac{1}{2}$ per cent Al. Mn.	23,000	20,250	12,500	1.3	3.9
Lab. $1\frac{1}{2}$ per cent Met. Cal.	24,750	16,000	9,500	2.0	3.9
Lab. 1 per cent Met. Cal.	24,370	18,000	8,500	2.0	5.9
Lab. $\frac{1}{2}$ per cent Cal. Al. Silicide.	24,430	19,000	8,500	3.7	7.8

In melting the turnings, most satisfactory results were obtained by first heating the crucible, or furnace to a temperature of 900 deg. C., then melting down in it a pellet of solid metal, preparatory to feeding in the loose turnings. This supplied molten metal to engulf the turnings at the outset, and permitted the puddling operation to go on at once. In the foundry this method of procedure has been applied with success, the loss

World's Copper Production

The production of copper in the world in 1914 amounted to 893,085 tons, a decrease of 91,775 tons from that of 1913. There was a falling off of more than 10 per cent. in the output of the United States, Spain, Mexico, and Australia, but that of Germany, estimated at 30,000 tons, represents an increase of about 5,000 tons over the preceding year.

FROM AMBER TO DYNAMO

PART XII—Construction of Direct-Current Dynamos

By H. E. Willmore, Jr., B.S.

Articles in this series are copyrighted by the author.

Direct-current generators and motors are both technically dynamos, although the term dynamo is generally applied in practice to generators. Both are constructed on the same general lines; in fact, by simply shifting the brushes it is possible to use a given dynamo as either a motor or a generator. A direct-current dynamo is made up in principal of a magnetic circuit and an electrical circuit. The magnetic circuit covers the following:

1. Yoke.
2. Pole Pieces.
3. Armature Core.

The electrical circuit is made up of:

4. Armature Windings.
5. Commutator and Brushes.
6. Field Windings.

The yoke, as shown in Fig. 29A, is the cast iron or cast steel frame that forms the foundation for the other parts of the machine. It also serves to conduct magnetic flux from one pole piece to the other, thereby increasing the magnetic strength of the poles. Cast steel is the best material for this, as it has both greater strength and greater permeability than cast iron, and so permits of a lighter construction. The pole pieces carry the field windings and by reason of their high permeability serve to intensify the magnetism of the field coils. They may be of cast steel, but are preferably built up of laminated steel sheets so as to reduce eddy current losses; while on small machines they are often cast in one piece with the yoke. The number of poles runs from two to four on small machines up to a dozen or more on large machines, but more commonly there are about six poles, as shown in the figure. Increasing the number of poles tends toward a greater efficiency of the machine, because it decreases the reluctance of the path of the magnetic flux. With large machines the increase in efficiency may

be quite appreciable. With a smaller machine, of say several hundred amperes, it is quite doubtful if the slight increase in efficiency gained by increasing the number of poles above two or four is large enough to offset the greater cost due to this complication of its construction. The faces of all the poles are curved so as to

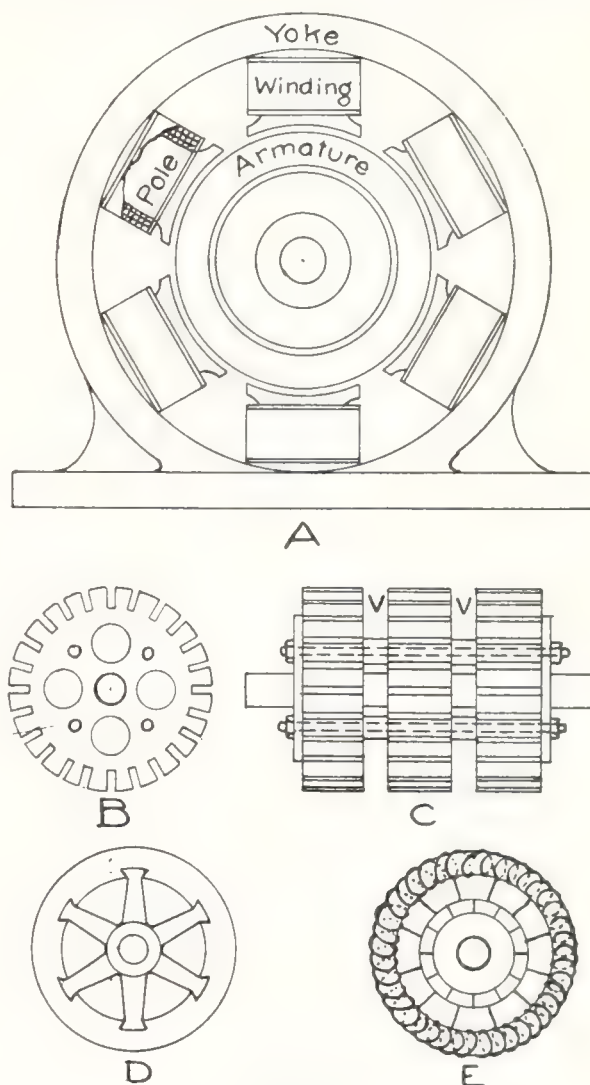


Fig. 29

come as close as possible to the rotating armature, and are of much larger cross section than the core, the reason for these precautions being that air is an extremely poor conductor of magnetism and it is attempted to offset this as much as possible by making the air gap between the pole face and the armature very short

and of large cross section. Laminated poles are rectangular, while solid poles are usually circular, which means that for a given size of cross section they require a smaller length of field copper. The "pole pitch" of a dynamo is the distance between adjacent poles.

FUNCTIONS OF THE ARMATURE

The armature core revolves inside of the field and carries the armature windings. Its magnetic function is to reduce the reluctance of the magnetic path between the poles of the field. At the same time it directs the lines of magnetism so that they will be cut by the armature conductors, giving a minimum amount of "magnetic leakage." It is, of course, laminated, and alternate sheets of steel are insulated with shellac to reduce eddy current loss. The metal itself must have a low hysteresis loss because it is subjected to very rapid changes of magnetism, by revolving inside of alternate north and south poles. The steel sheets of which it is made are punched out as shown in figure 29-B, with teeth between which the conductors are wound, so that armature iron and conductors are flush. In this way, the air gap between the armature core and the pole pieces is much shorter than if the conductors were simply wound on a cylindrical surface. As shown here, holes run from one end of the armature core to the other and in assembling the laminations, spaces are left occasionally as at V in figure 29-C. The object of these vents is to allow free passage of the air. Heat is produced in the armature core and windings due to hysteresis loss in the iron and resistance losses in the armature windings and this heat must be conducted away, for if the temperature be allowed to rise too high in the armature the insulation may be damaged. In small machines, the sheets may simply be clamped together on a shaft by means of heavy end plates and bolts. In larger machines, the armature punchings have one large hole in the center and are carried, as shown in Fig. 29-D on a cast iron or steel spider which also supports the commutator.

The armature winding is the system of revolving conductors which by cutting the magnetic flux, generate an e.m.f. For a

given speed of rotation of the armature the e.m.f. generated is proportional to the number of these conductors that are in series, and the current that flows is proportional directly as this e.m.f. and inversely as the total resistance of the armature circuit. In low voltage generators furnishing a heavy current such as are used for electro-plating, there are comparatively few conductors in series, and they are quite heavy.

These armature windings are of course connected at every few turns to commutator bars, which are in turn tapped by brushes at intervals corresponding to the pole pitch, and the current thus conducted away for use. The earliest type of armature, known as the ring or gramme winding is illustrated in Fig. 29-E. Here it is seen that the armature core is in the form of a ring and the conductor is wound continuously around it. This kind of winding has the disadvantage that the part of the conductor which is inside of the armature core does not cut lines of force and therefore is not only wasted, but serves unnecessarily to increase the resistance of the winding, as well as the weight and cost of the machine. Further, the winding is difficult to build in the first place and much more difficult to repair in case of injury than in other types of winding. This winding is now obsolete and the only one in use is the drum armature type. In this form, the core of which was first described, the winding is entirely on the outside, where all of it takes part in generating e.m.f. This winding is not continuous, but is built up of separate coils, which are formed as shown in Fig. 30-A before winding on the armature and are then fitted into slots in the armature core as shown in Fig. 30-B, with one side of a coil in the top of a slot and the other in the bottom of a slot. In order that the e.m.f. generated in both sides of the coil may be in the same direction with reference to the conductor, the two sides of the coil must be in fields of opposite polarity, therefore these two sides of the coil are fitted into slots which are a distance apart approximately equal to the pole pitch of the machine. Each of these coils may consist of one or several turns of wire; with low voltage, high current machines, they are formed of a single

bar. In Fig. 30-C, the light and heavy dotted lines show the directions taken by the windings at the end of the armature and Fig. 30-D gives an idea of the appearance of the finished armature.

ARMATURE WINDINGS

Armature windings are of two kinds: multiple or lap windings, and series or two-circuit windings, sometimes called "wave" windings. The conventional method of representing a multiple winding is shown by the heavy lines in Fig. 31-A, where the small rectangles represent commutator bars. It will be noticed that in this form of winding, the ends of each coil are connected to adjacent commutator bars. Fig. 31-A also shows the method of connecting these coils to each other and to the commutator bars. When the coil pitch (the distance between the two sides of the coil) is approximately equal to the pole pitch, as in Fig. 31-A, it is said to be a full pitch winding, which is the one more commonly used. If the coil pitch is very much less than the pole pitch, it is called a "fractional pitch" or "short-cord" winding. This latter scheme tends to reduce sparking between the brushes and the commutator, because the conductors in the same slot are not being commutated at one time, and therefore the inductance is not so great. The e.m.f. of a generator is proportional inversely as the number of paths in multiple (parallel) between positive and negative brushes, while the amperage of course is directly proportional to the number of paths in multiple, as explained before. Tracing through the path from any one positive brush to the next negative brush in Fig. 31-A, you will see that only one-sixth of the conductors on the armature have been passed over, so that in the entire armature there are six distinct paths from a positive to the nearest negative brush. If now, instead of connecting the two ends of each coil to adjacent commutator bars, we should connect them to alternate bars and then should fill in the spaces left with another winding, we should then have twelve paths in parallel between brushes, or twice as many as there are brushes, giving what is known as a "duplex" winding. Three times as many paths as there are brushes gives a

"triplex" winding, etc. While we increase the number of paths we are decreasing the voltage and increasing the amperage output of the machine, so that these "multiplex" windings are quite suitable for electro-plating dynamos. Fig. 31-B shows a "duplex, doubly re-entrant, multiple" winding. To understand the meaning of the term "doubly

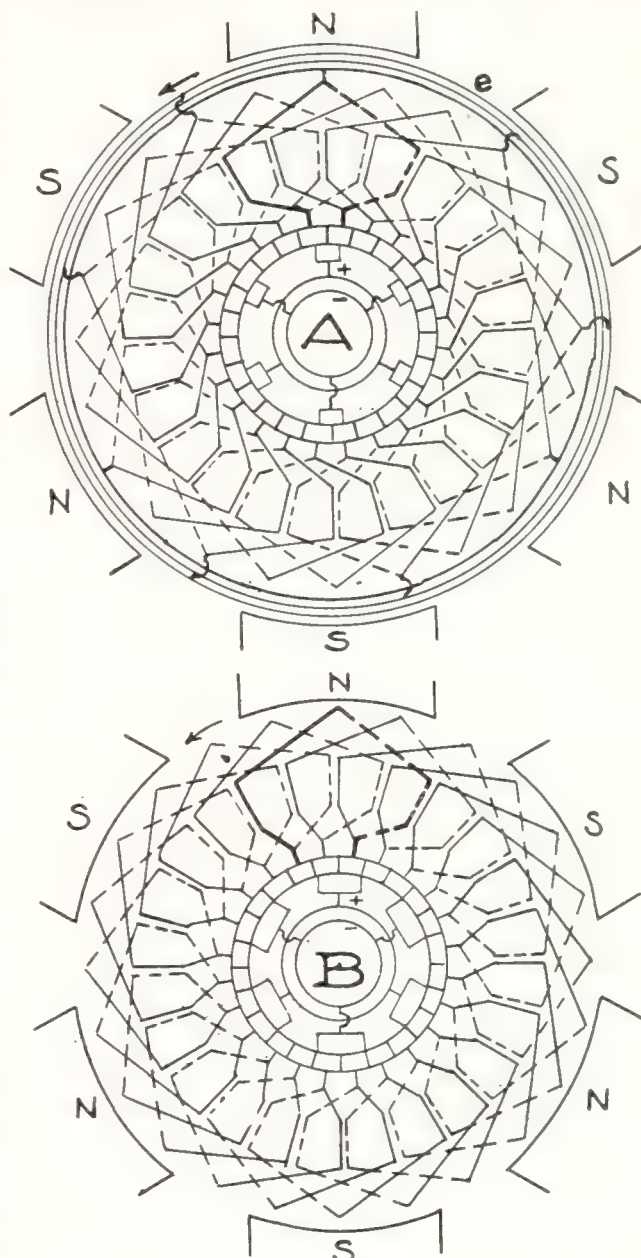


Fig. 31

re-entrant," the reader should select some point on the winding and trace a continuous path around the entire winding until he comes back again to the starting point. He will notice that in so doing he has covered only half of the winding and in order to cover the other half, he will have to make a fresh start on the adjacent coil, or in other words, "re-enter" the winding. If after passing through the first winding, the

circuit itself re-enters the second winding, passes through it and then re-enters the first winding, the system is called "singly re-entrant." With a duplex winding the brushes must always be large enough to cover two commutator bars, with a triplex winding, three bars, etc. In multiple windings, unless everything about the machine is very nicely balanced, as to strength of field, air gaps, brush spacing, etc., the e.m.f.'s generated in different parts of the windings will not be exactly the same and this condition will cause current to circulate wastefully even when no power is being taken from the machine, tending to increase the heating of the armature and to cause sparking. To obviate this condition, heavy conductors called "equi-potential connectors" or "equalizer rings" are connected to commutator bars which are similarly placed and should therefore be at the same potential. These rings will not stop the heating of the windings, but will reduce the sparking when no load is on the machine.

In the series-drum type of winding, the ends of the coil are connected to commutator bars which are a distance apart approximately equal to twice the pole pitch, as shown by heavy lines in Fig. 32. In Fig. 32, tracing out the winding once around the armature, it ends up with the bar next to and behind the one from which you started, making what is known as a "retrogressive" winding. If tracing once around the armature brings you to the bar ahead of the one you started from, the winding is said to be "progressive" (not shown). In either case, tracing the path through the windings from one positive brush to the next negative brush, you will find that you have covered half the conductors, showing that in a series-drum winding there are only two paths in multiple between brushes, for which reason this type of winding is used only for quite high voltage generators and motors. Series-drum windings may also be multiplex, and multiply re-entrant. To distinguish between multiple and series-drum windings look at the windings as they run from the commutator bars to the slots. If these wires are parallel on both ends of the armature the winding is multiple. If the wires run in the opposite direction on

one end from what they do on the other end, the winding is series. Obviously, a plating dynamo should have a multiple drum, although a catalogue published by one company claims that their plating dynamo has a series winding, which, however, may simply be a mistake in the writing of the catalogue.

FUNCTION OF THE COMMUTATOR

The function of the commutator has been explained before (part XI). It consists of a number of bars of forged copper, held on a ventilated cast iron spider from which they are insulated by micanite. The bars are also insulated from each other with the same material,

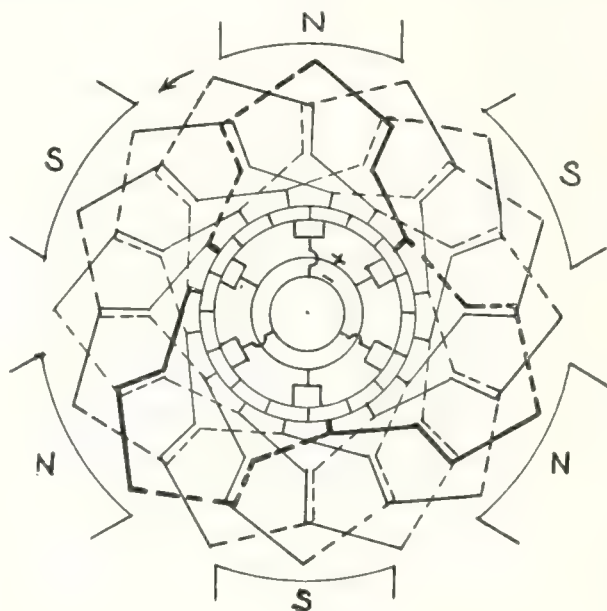


Fig. 32

as shown in perspective in Fig. 33-A and in section in Fig. 33-B. The windings are connected to the projections shown at the back of the commutator bars either by screw connections or by soldering. Soldering gives a better contact and one which will not work loose so easily from vibration; but in case of excessive overheating of the machine, the solder may get soft, so the best system is to use both screws and soldering. The commutator is a quite important and expensive part of the machine and quite difficult to replace and should therefore receive the best of care. It should be perfectly round and quite smooth in the first place, to prevent chattering of the brushes, and should be carefully protected from excessive wear due to grit or sparking. Brushes may be of metal or graphite. Metal brushes are used where

the currents to be carried are quite heavy, as in plating dynamos, and are usually of copper built of sheets or gauze in order that they may be flexible. They are likely to wear too much on the commutator, however, and on higher voltage machines, where it is permissible, graphite brushes are used, which are self-lubricating and which greatly improve commutation. With multiple winding on the armature there should be as many sets of brushes as there are neutral points in the field, which corresponds to the number of poles; whereas with a series drum, only two brushes are necessary. The brushes are held in copper or brass brush-holders, a simple type of which is shown in Fig. 34-A, arranged preferably to carry the brush perpendicularly to the commutator, as then it will wear and be fed by the spring uniformly, and require no adjustment. If the brush is of graphite a heavy lead should be firmly bolted to it, the other end being as firmly attached to the brush holder, because contact between the graphite and the holder is not at all dependable, while the spring which presses the brush down against the commutator should not be made to carry away the current because it would heat and lose its temper. The brush holders are carried on the projecting bars of a frame-work similar to Fig. 34-B, which is fastened to the frame of the machine, but with some freedom of motion so that the position of the brushes may be changed at will.

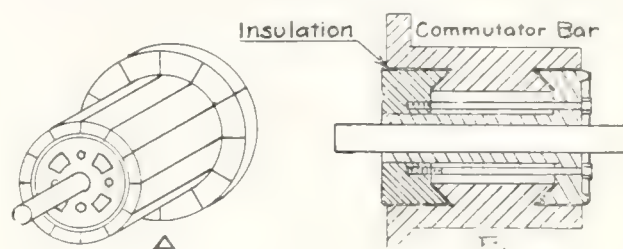
THE DYNAMO FIELDS

According to the method of excitation, dynamo fields may be divided into the following classes:

1. Permanent magnets.
2. Separately excited.
3. Series winding.
4. Shunt winding.
5. Compound winding.

Permanent magnets are used only in magnetos, in connection with telephones and gas engines, and will not be taken up here. Fig. 35-A is a conventional representation of a separately excited system in which the field is magnetized by running some outside current, usually from a direct current lighting circuit, through the field coils. Sometimes

a small direct dynamo, called a "separate exciter" is connected directly to the shaft of the large machine. There is of course a rheostat R in series with the field circuit, which enables the operator to control the voltage of the machine. With a given setting of the field rheostat, the voltage will drop slightly as more current is taken from the brushes. Fig. 35-B



Figs. 33 and 34

shows the series-field winding. A shunt around the series field, S , may be used to vary the field; but it is seen that with a given setting of this shunt, the amount of current flowing through the field is proportional to the total current output of

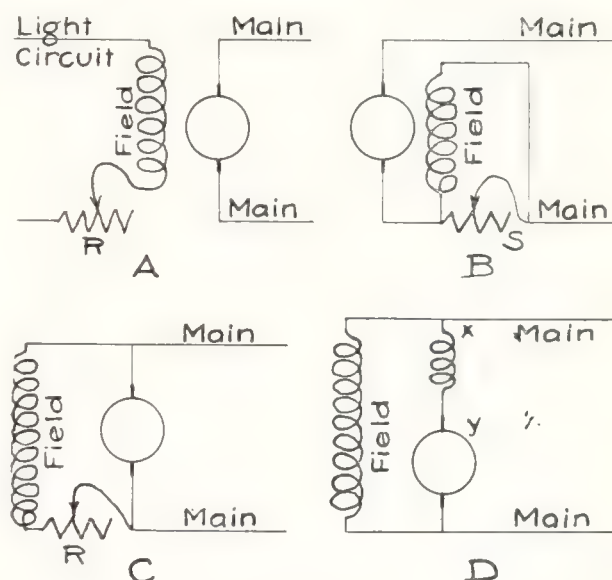


Fig. 35

the machine, hence the voltage rises with the current and such a machine is entirely unsuited as a generator where steady voltage is desirable. Fig. 35-C shows the shunt-field system where the field is connected in parallel with the brushes, with a field rheostat in series with the field to control the amount of current passing through the field coils. With a given setting of the field rheostat the amount of current passing through the field coils will decrease as the amount being taken from the brushes increases, therefore as the current output increases the field will become weakened

and the voltage will drop. For use where a constant current is being taken, this form of winding is all right; but for the plating room where a very steady voltage is necessary and at the same time the amount of current being used changes frequently as work is taken out of and put into tanks, it is necessary to be constantly changing the field rheostat to keep a steady voltage. This form of winding was formerly used very much, and is even now, by a few supply houses, being sold for plating purposes, but it has been largely supplanted by an improved type of machine known as the

ator there is no current flowing through the field windings, and the poles are of course not magnetized by the windings; but there is usually a little magnetism left in the iron itself (residual magnetism) and the armature coils first cut this weak field and a little current is sent through the windings, which then strengthens the field a little more and the field thus gradually builds up. If there is no residual magnetism, the field will not build up, and it will be necessary to send current through the generator from an external source.

Trade Opportunities

The names and addresses of subscribers who have sent in any of the following inquiries will be furnished to any of our advertisers on application.

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Can you inform me where I can get a receipt for aluminum flux for autogenous welding. Perhaps you can inform me where I can buy the best flux. We have tried a few kinds but none do the work as we would like them.

We would like a flux that would make the metal flow together the same as cast iron when welding.

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We are in the market for 2000 gross brass drop forged wing nuts, for export.

Perhaps some of your advertisers may be in a position to furnish them and wish you would be good enough to put us in touch with them.

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Can you tell me where I can buy extra fine table cutlery, such as knife blades, etc., also if there is any place I could buy small sterling silver castings such as knife handles.

Automatic Screw Machines

We are very anxious to secure information regarding the best methods for cleansing brass work as turned out in automatic screw machines. In all probability we shall increase our equipment for this department of our work and any information that you can give us relative to processes that have worked out most successfully, or references to companies which would be in a position to give us an up-to-date equipment, will be sincerely appreciated.

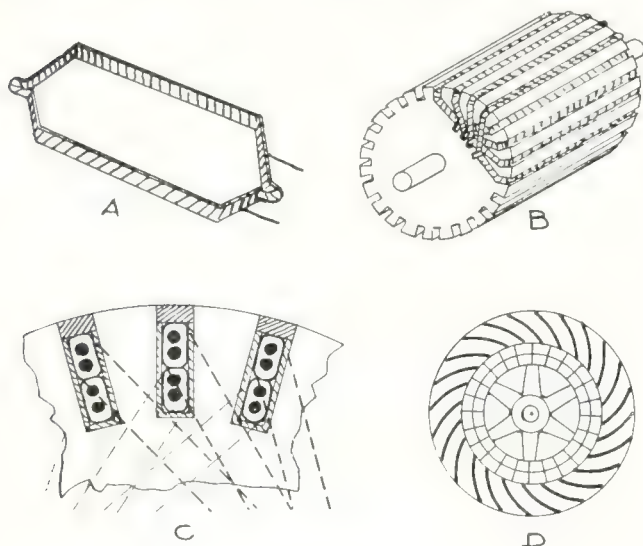


Fig. 30

compound dynamo. In this, which is illustrated by Fig. 35-D, a series and a shunt winding are put upon the same pole piece. The result is that as the shunt winding takes less current due to an increase in current output, and thus tends to reduce the field strength, the series winding takes more current and thus keeps up the field strength. By properly proportioning the sizes of these windings, the field may be so adjusted that the generator will have the same voltage at full load as at no load, although there is a very slight variation of the voltage in between these two extremes. If the upper end of the shunt winding is connected to the upper end of the series winding at *x* as shown, the generator is known as a "long shunt" compound generator; but if it is connected to the inner end of the series winding at *y*, it is known as a "short shunt" compound generator. It makes very little difference which one is used.

Before starting a self-excited gener-

Abraham Van Winkle

The passing of Abraham Van Winkle at his home in Newark, N. J., at the age of 77, has been a distinct loss to the personnel of the trade, and has seemed like a personal affliction to a wide circle of friends.

The activities of Mr. Van Winkle in this trade, and the very wide influence of the Hanson & Van Winkle Company, due to Mr. Van Winkle's untiring initiative, made him a commanding figure.



Mr. Van Winkle was born in Pompton, N. J., and was of Dutch descent. As a young man he essayed the drug business in Newark, but in 1870 he became attracted to what was to prove his real life work.

He was an indefatigable traveler, and due to his habits of study and observation his journeyings were always fruitful. With Mr. Weston he was interested in the development of the first low-voltage dynamo made in this country, and it was exhibited at Philadelphia in 1876, and from there had a wide European success. He was at one time an associate in the Brush Electric Company, and due to the success of his various installations that company and others consolidated as the U. S. Electric Lighting Company. He made trade history along the lines of his endeavors, and with it all prosecuted a scholarly interest in the theories of his chosen calling that made him a friend and associate of scientists in several professional lines.

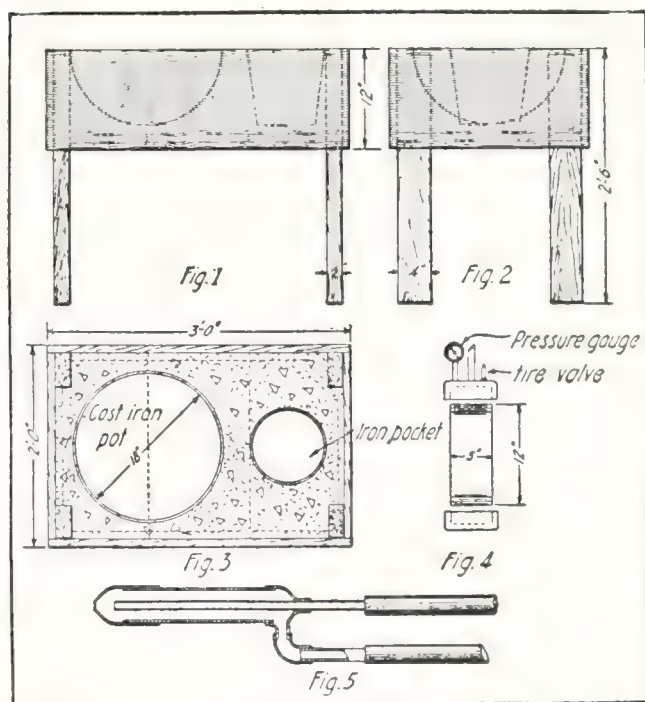
The good he accomplished lives, and will endure as the finest monument to his memory in his public and business career.

Making a Gas Forge

A demand for an intense heat, cheaply and quickly obtained, and suitable alike for forging, brazing, and light casting work is often met with by both the professional and amateur. For this purpose a permanent gas forge can be made at small expense and a minimum amount of labor. With this forge any kind of work requiring a heat not over 2000 deg. can be performed quickly, with a cleanliness approaching the old-style blacksmith's coal forge.

Except that air and illuminating gas are used for fuel, the principle employed is similar to that used in the construction of the powerful oxy-hydrogen and oxy-acetylene blow torches. While gas and air are incapable of developing the intense heat of the more powerful gases, the fact that illuminating gas can be obtained cheaply more than offsets the loss in calorific value.

In the drawings are shown the forge both in part and completed state. The materials required for the body of the forge are: Two pine boards, 3 ft. by 12 in. by 1 in.; five pine boards, 2 ft. by 12 in. by 1 in.; four 2-in. by 4-in. boards



Details of a gas forge which can be made cheaply and with little labor

2 ft. 4 in. long; one cast-iron refining pot or substitute to be use as firepot; one 2-gal. galvanized iron bucket; ten buckets concrete (mixed one part cement, two parts sand, four parts small gravel); for

surface, two buckets concrete in the proportion of one part cement to two parts sand.

Fig. 1, a simple box 3 ft. by 2 ft. by 1 ft., is constructed; a 2-in. by 4-in. scantling is fitted in each corner and securely nailed, to act as legs. The upper end of the legs must be kept several inches below the surface of the forge, as the concrete obtains a better bearing on them and the top of the forge is kept unbroken by protruding wood.

Next, the refining pot and bucket are set in place in the concrete mold and the concrete, mixed in the proper proportions, is run in about them. Several inches of concrete must be placed between the firepot and bottom of the form to prevent fire, in case it is decided to leave the form intact after finishing.

If desirable, concrete legs or brick pillars may take the place of the pine legs. If it is decided to remove the wooden form, the legs should be only lightly nailed in place and bolts should be run through them with the ends well embedded in the concrete. The form may be left in place, as the risk of fire is negligible. And it is possible to fasten tool racks, etc., to the sides where they will be most convenient.

In practice, fire clay, asbestos, or coke will be used to line the fire pot to protect the iron pot from melting. In case an iron fire pot is unavailable the fire hole may be built up of concrete, fire clay, or even ordinary clay to which 10 per cent sea salt has been added as a glazing agent. The bucket beside the fire pot may be filled with water and used for cooling and tempering purposes.

The materials necessary for the blow torch are: One piece 1-in. gas pipe, 4 in. long, threaded and for 1 in. at one end; one piece $\frac{3}{8}$ -in. gas pipe, 8 in. long, and threaded for 4 in. one end; one tee, reducing from 1 in. to $\frac{3}{8}$ in. straight through and to $\frac{1}{2}$ in. on the angle; one male and female ell, $\frac{1}{2}$ in.; one piece $\frac{1}{2}$ -in. gas pipe 3 in. long, threaded one end; two pieces hose $\frac{3}{4}$ -in. inner diameter and 3 ft. long. The sizes of pipe and fittings are measured by their inside diameter and can be bought from any plumber.

To assemble the blowpipe the $\frac{3}{8}$ -in. pipe is screwed through the tee from

the 1-in. side until about 3 in. projects to receive the hose which comes from the air chamber. The male portion of the ell is screwed into the angle inlet of the tee and the 3-in. piece of $\frac{1}{2}$ -in. pipe is fastened to it. This pipe connects with the hose which leads to the gas main. An idea of their proper arrangement can be gained from Fig. 5.

At the mouth of the torch a $1\frac{1}{4}$ -in. piece of steel tubing 3 in. long is slipped over the outer tube. This sleeve should be cut as shown in Fig. 6, and bent until curved, as shown in Fig. 5. The perfect combustion of the gas depends largely upon this cap, as it interrupts the flow of the gases and thoroughly mixes them. Provision should be made to allow this cap to slide freely for adjustment.

As compressed air is readily obtainable, it would be well to replace the bellows or blower with an air tank. A simple tank may be made from a piece of steam pipe 1 ft. long and 5 in. in diameter, threaded for caps at both ends. Threaded into the top cap must be an automobile tire valve, a pressure gage and the outlet pipe. The outlet pipe must be fitted with a stop cock which should be placed beside the gas cock. The arrangement of the air tank is shown in Fig. 4.

The torch is first lighted by turning on the gas. After the gas is lighted the air is gradually turned on until the torch flame burns almost colorless except for a small cone of greenish gas at the mouth of the torch. The closer the cap is adjusted the smaller this cone will become. As this cone represents unburning gas the hottest part of the flame is at the colorless outer tip.

The torch is held in the hand and the flame directed as required. If the heat is found unbearable a metal shield can be made and the flame then directed through this.—Popular Science Monthly.

What a Patentee Can Claim

In the case of Individual Drinking Cup Company v. United States Drinking Cup Company it was held that a patentee is deemed to claim every form in which his invention may be copied unless he manifest an intention to disclaim some of those forms or where form and substance are inseparable.

Die-Casting Practice

By CHAS. PACK*

Die-castings may be defined as finished castings, the metal having been poured and allowed to solidify in permanent metallic molds. This definition would include a number of casting processes, the products of which are not commercially recognized as die-castings, such as the casting of cheap lead figures, lead battery plates, dental appliances, etc. Here the molten metal is poured from an iron ladle into a permanent metallic mold, filling the mold by its own gravity and using no external pressure. To exclude these processes, die-castings must be defined as "finished castings made by pouring molten metal under pressure into a metallic mold."

The process of die-casting consists essentially in melting the die-casting alloy in a suitable container and forcing it, under pressure, into a metallic mold or die, producing smooth finished castings requiring little or no machining, and being ready for buffing or plating without any grinding or cutting down. The process is best adapted to small intricate parts where accuracy and uniformity are essential. The process is limited to a group of alloys having a tensile strength not exceeding 20,000 lb. per sq. in., which limits the application of this process to machine parts not subject to severe strain or shock. It is, however, possible by a careful study of the service conditions to re-design castings, either by the addition of ribs, webs, fillets, etc., or by the insertion of steel or bronze inserts to so strengthen die-cast parts that they may successfully displace the stronger alloys of copper and iron.

Although the principles of die-casting have been known and practised for many years, the advent of successful die-casting as an individual industry dates back to a period of no more than fifteen years. By careful study and experiment it has become possible to enlarge the area of its application, and at the present time the manufacture of die-castings forms an important branch of the non-ferrous metal industry.

Die-castings are now used extensively for both useful and ornamental purposes. They constitute the vital parts of various types of automatic vending machines, photo-

graphing machines, typewriters, cash registers, magnetos, motor starting devices, time controlling devices, counting machines, water circulating and force feed pumps, player pianos, roller and ball bearings, connecting rod and crank shaft bearings for internal combustion motors, gas meters, electrical measuring devices, mechanical and electrical horns, phonographs, and for many other purposes too numerous to mention here.

The processes in use for the manufacture of die-castings may be divided into two groups, viz.: Air machines and plunger machines. In the former type of casting machine, the metal is melted in a suitable iron pot fitted with air-tight cover. The air valve is opened to admit air, which forces metal upward into the die. Although there are a number of air machines where metal is poured downward with gravity, the greater number called to the attention of the writer force the metal upward and against gravity.

The plunger type of casting machines, although open to a number of objections, have proved more successful in practice and are used to a much larger extent than the air machines. The writer will confine himself to the machine and process patented by H. H. Doehler in 1907.

Dies are constructed from model or blueprint furnished. The design and construction of the dies constitutes one of the most vital factors in the successful operation of the process. The designer of the die must find the proper location for the gate, which is a very important factor, far more so than in foundry practice. A machine part often pronounced a casting impossibility may be made a possibility by the ingenuity of the die designer.

A better understanding of the importance of the die construction may be gained by a consideration of the die cost. Dies for simple parts may cost from \$25 to \$100; for more intricate parts from \$100 to \$500, and for very complicated parts die cost may run as high as \$1,000. Although the latter figure seems high, die castings made from such dies still show big savings, since otherwise there would be no demand for such dies.

The predominating features of die-castings are their high degree of accuracy and uniformity. Die-castings can be made to specifications of plus or minus 0.005 in., and

*Doehler Die-Casting Company.

when necessary, if conditions permit, to specifications of plus or minus 0.0005 in. These conditions depend upon the alloy to be used and construction of die. Generally, specifications of plus or minus 0.0005 in. can only be had on castings whose dimensions do not exceed 1 in. either way. It must, however, be understood that closer specifications require more careful die work and consequently higher die cost. Limitations should, therefore, be made as liberally as requirements will permit. From the foregoing it will readily be seen that in the construction of dies only high skilled mechanics can be employed. The employment of inferior labor in this department would be a false economy, since a single mis-step may ruin weeks of good work.

The alloys used for die-castings may be divided into three groups, viz.: A, zinc alloys; B, tin alloys; C, lead alloys. The writer in his experience has found the constituents of Group A alloys to vary as follows:

Zinc	70 to 90 per cent.
Tin	0 to 20 per cent.
Aluminum	0 to 5 per cent.
Copper	2 to 5 per cent.
Antimony	0 to 2 per cent.
Lead	0 to 2 per cent.

A typical example of this group of alloys is the following:—Zinc, 84.5 per cent.; tin, 9.0 per cent.; copper, 4.5 per cent.; aluminum, 2.0 per cent. Zinc alloys of the type given have a tensile strength not exceeding 18,000 lb. per sq. in., and an exceedingly low elongation and reduction of area. The strength of these alloys compares favorably with cast iron. Zinc alloys are corroded by aqueous solutions of any kind, and should not be used for food containers or conveyors. Gasoline, which theoretically should be inert toward metals, has been found to corrode zinc alloys, when in direct and constant contact, due to impurities in the commercial gasoline sold to motorists. A good copper-plating, however, will aid a zinc alloy to resist the action of gasoline.

Zinc alloy die-castings may also be plated with nickel, silver, brass, etc., and such coatings protect the castings from corrosion. Zinc alloy die-castings may be buffed to a beautiful white polish, which, unfortunately, becomes dull upon exposure to atmospheric conditions for a few days. A permanent white polished surface may be imparted to zinc die-castings by electro-

plating with nickel and buffing. Of all die-castings produced on this Continent and in Europe, approximately 85 per cent. are made from zinc alloys, 10 per cent. are made from tin alloys of group B, and 5 per cent. from lead alloys of group C.

An understanding of the extensive application of zinc die-castings may be gained by a partial enumeration of the parts for use in the motor vehicle industry; Magnetos, self-starting devices, water-circulating pump bodies, force-feed oil pumps, ball-bearing cages, speedometers and wing nuts for windshields. Many of the inventions patented annually would not be commercial possibilities if the present-day zinc alloy die-castings were not available. The numerous automatic vending machines on the market today illustrate this fact.

Group B alloys, containing 60 per cent. and upward of tin, may be said to consist entirely of babbitt metals. The original tin, antimony, copper alloy patented by Isaac Babbitt, has undergone numerous changes. Constituents have been varied, lead and zinc have displaced the higher-priced tin in many cases, and at the present time any white metal alloy used for bearings is usually styled babbitt metal. Die-castings of this group are mostly used for motor bearings, although they are also used for machine parts where resistance to corrosion is of major importance and where high tensile strength is not required.

In the die-casting process, the metal is poured under pressure into a water-cooled metallic mold. The rapid chilling produces a close-grained babbitt bearing, free from blows and dross spots, so often encountered in the place-poured bearing. An automobile concern producing 50,000 cars per year has used successfully die-cast bearings for eight years without a single complaint and many die-cast bearings on that particular make of car have traveled 50,000 miles and more, only requiring slight adjustment occasionally. The alloy we use is of the genuine babbitt type, i.e., containing only tin, copper and antimony in proportions varying only slightly from the original Babbitt formula.

The die-casting company producing these bearings uses only primary Straits tin, Cookson's antimony and the finest drawn or rolled Lake copper. This alloy is mixed by a process in which no constituent is heated above 750 deg. F., and, after mixing it, it

is kept below this temperature until cast. Die-cast bearings made in this manner are far superior to those cast in place around the shaft and also more economical.

Under this group of alloys mention must also be made of Parson's white brass, an alloy of tin, zinc and copper. This alloy cannot be cast in the plunger type of machine (due to freezing of plunger), and only with difficulty in the air machine. The alloy, although partially molten at 400 deg. F., is not thoroughly fused and entirely liquid until a temperature of 1,000 deg. F. is reached, at which temperature the alloy drosses excessively, segregates easily and is in general a poor die-casting alloy. There has been, however, a demand for die-castings of the tin-zinc copper type, and this has caused the placing on the market of a bearing metal known as Comet white bronze, and alloy consisting essentially of tin, zinc and copper, in such proportions and treated in such manner as to overcome the objections to which Parson's white brass is open, although retaining its good bearing qualities.

Group C alloys containing 60 per cent. and upward of lead, are so well known as to require no further discussion here beyond saying that the die-casting process is not limited to any particular composition and is applicable to all alloys of this type.

In this field of metal sickness research we may find corrosion, electrolytic action, and so forth.

Alloys disintegrate. A freshly-made alloy in the presence of moisture may lose its strength. The structure of aluminum alloyed with tin may give at first a tensile strength of two or three times the pounds per square inch that in a few weeks would be given by the same specimen.

When freshly cast the structure of that alloy would show a firm, close grain if examined under the microscope, but later on the sickly alloy showed up entirely different crystals and when broken the fracture, while new, gave off an odor of silicon hydride. Presence of water in such cases produced a gas which rotted the alloy just as the ailments of dread infection or gangrene attack the human body.

Probably, by negligence, the overheated aluminum took up silicon from the crucible. Iverson advises that these alloys be melted without fluxes—fluxes such as mixtures of sodium and potassium chloride. Zinc

chloride, as he points out, acts upon the crucible and the aluminum dissolves out the silica, which, in the presence of moisture, liberates silicon hydride that in time causes the disintegration leprosy of the alloys.

However, there are fluxes that in Iverson's opinion are permissible. He advises phosphide of copper added in quantities of 1½ per cent. to a zinc-aluminum alloy containing from 12½ to 15 per cent. zinc to give fluidity to the melted metal. Phosphide of zinc containing 25 per cent. phosphorus can be substituted advantageously in the proportion of 0.05 per cent. This is claimed to be one of the best fluxing and cleansing agents for all aluminum alloys. It should be added to the alloy when molten a few minutes before pouring.

Too high a temperature in melting should be avoided. And too high means a temperature over what is absolutely necessary for fluidity.

So much for purely chemical or electrolytic action. Turning to mechanical tangles, we find that Goldberg in his investigations at Gross-Lichtergelde (*Giesserei-Zeitung*) finds that neither silicon nor nitrogen plays any important part in the disintegration of aluminum articles while in stock prior to being used.

He found the crust and blisters to consist almost wholly of alumina. Changes of temperature were without influence. Distilled water had less corrosive action than the untreated water, particularly as regards irregular and local pitting.

His conclusions were that the trouble was electrolytic and depended in the main upon differences of potential between unequally hard portions of the aluminum. For the cure of this condition he suggested that the work should be carefully heated to 400 to 450 degrees and then slowly cooled.

This investigation by Goldberg is further testimony to the importance of equal action upon the metal when being mechanically treated, pressed or otherwise machined, and shows another and rather curious angle of the electrolytic question.

There is room for more extensive research along this line. Especially is there an attractive chance for study in the combination of dissimilar metals having pronounced galvanic or electro-chemical differences one with the other.

Keep your eye on the Brass World.

Recent Progress in Pyrometry*

In view of the present recognition of the value of scientific research, it is interesting to note that, apart from the work of government institutions, such as the National Physical Laboratory and the United States Bureau of Standards, practically all recent progress in pyrometry has been due to the efforts of instrument makers, and little of importance has emanated from our educational institutions. At the present moment most of our physicists are absorbed in atomic and molecular physics, to the exclusion of the industrial applications of their science. Hence it has been left to the manufacturers of pyrometers, chiefly in Britain and America, to furnish the improvements in methods, and to extend the applications of high-temperature measurements to the industries. The work accomplished in this direction deserves a much wider scientific recognition than it has received; and it is to be hoped that in the future any funds earmarked for research will be spent largely on investigations definitely directed to the improvement of our industries. It is satisfactory to be able to state that, as the result of scientific methods, British makers of pyrometers are not merely independent of other countries, but stand unrivaled in regard to the quality of their instruments.

Although, since 1910, no pyrometers based upon new principles have been introduced, many detail improvements have been made. To overcome the difficulty of the impurities in the metals used for determining the fixed points, the United States Bureau of Standards now issues materials of certified fixed points, so that any user of pyrometers may check or re-calibrate his instruments with accuracy. This procedure might, with advantage, be followed by our own National Physical Laboratory, which is the center of accurate pyrometer standardization in this country. It has been suggested that a better plan is to keep an accurate, certified pyrometer for such purposes, and no doubt this is the case in very large establishments. In places where only two or three pyrometers are in use, however, the expense of a standard instrument, purely for testing, is not warranted; and it would be a great benefit to the small user if materials were available

which he could rely upon to check the accuracy of his instruments. Instructions for use could be issued, insuring, if followed intelligently, a correct result.

Some New Thermo-Couples

The past few years have witnessed a great extension of the use of base metals in the construction of thermo-junctions. This is due not merely to the almost prohibitive price of platinum and kindred metals, but to the fact that properly chosen base-metal couples develop a relatively high electromotive force, and therefore enable a strong and cheap indicator to be used in place of the sensitive instrument required for couples of the platinum series. Considerable doubt having been thrown upon the reliability of base-metal junctions by Kowalke (*Transactions of the American Electrochemical Society*, 1913-14), Mr. C. R. Darling has tested an iron constantan pyrometer which has been in use in his own laboratory for nearly three years, during which time it has been repeatedly heated to 850 deg. C. At the melting point of zinc (419 deg. C.) the calibration was strictly correct, and at 800 deg. C. the reading was only 5 deg. too low. This pyrometer was of the heavy type, made by welding a constantan rod to an iron tube, and the slight error thus shown after repeated use compares favorably not only with junctions made of platinum and its alloys, but with any type of pyrometer whatsoever. The general experience of users of base-metal couples of British manufacture is that the changes in calibration were much less than those recorded by Kowalke (20 deg. to 130 deg. C.), which, if generally true, would entirely discredit this class of instrument. An important investigation of junctions of carbon and graphite has been made by C. C. Bidwell, who was able to read temperatures as high as 2000 deg. C.

It is necessary to subject the junction to a preliminary heating at this temperature before calibration, in order to remove volatile impurities, when constant readings can be secured. Both carbon and graphite can be obtained in thick rods, and can be machined, so that it is possible to build up a robust pyrometer with these substances. If this couple be found to meet the requirements of industrial practice, it should prove extremely useful for temperatures exceeding 1200 deg. C., and may solve the out-

**The Ironmonger*. London, abstract of a paper read before the Royal Society of Arts, by Charles R. Darling.

standing problem of determining the temperature of molten steel in the ladle. Its experimental utility is established.

The Importance of Temperature Measurements

Sir Robert Hadfield, who was in the chair, expressed the thanks of the meeting to the author for his paper, which, he said, was most valuable. It was astonishing to note the progress which the development of pyrometry during the last twenty years had enabled metallurgists to accomplish. To-day not only did the pyrometer represent highly specialized scientific apparatus, but it was practical, and with hardly any practice could be handled with success by those who have had even but little experience. It was Le Chatelier who practically started the modern resistance pyrometer. Excellent work was also done in this country by Sir W. C. Roberts-Austen, assisted by Mr. H. C. Jenkins, who was present that evening, and by Prof. H. L. Callendar, by whose accurate instrument it was possible to determine temperature to exceedingly fine points—less than 0.1 of 1 deg. C. As showing the extremes of temperatures which have been measured, it might be mentioned that Prof. K. Onnes had been down to within $1\frac{1}{2}$ deg. of the absolute zero. At the other extreme Mr. O. Lummer claims to have reached as high as 6090 deg. absolute (about 5800 deg. C.) by impregnating the carbons of the electric arc and working it under high pressure, this artificial temperature approximating to that of the sun. Dr. Whipple of the Cambridge Scientific Instrument Co. had done most useful work in developing the manufacture of both electrical and optical pyrometers, the latter being a comparatively new application now largely made use of; also Johnson & Matthey, who had been to such great pains in providing pure platinum and platinum alloy ingots of correct composition; also Dr. G. K. Burgess of the United States Bureau of Standards, D. C.

Why Chemical Dealers Don't Answer

This is perhaps explained by the statement of an official of one company that at the outbreak of the war they were swamped with inquiries regarding rare chemicals and alloys. After spending a great deal of time, they looked up a few of the inquiries and became convinced that they were dictated by German agents who

wished to find out what this company was going to do in the matter of supplying various materials which usually came in from Germany.

Lots of Lead and Copper

A semi-official communication, after descanting upon the inability of Germany's enemies to reduce the country by famine, proceeds:

"It is extremely gratifying to know, as a result of our careful investigations and estimates, that the stocks of metals of industrial, and especially of military importance, in the possession of private owners are astonishingly large and in excess of all expectations. We shall never be in want of lead. But if scarcity should ever set in such huge quantities of lead are available, especially in the form of lead pipe which could be replaced by iron and other pipes, that every conceivable need would be covered for a long time ahead. And of copper the military authorities have at their disposal at this moment enough to outlast the probable duration of the war. Even if the war should drag on for more than a year, as our enemies sometimes affect to believe, we should still have enough copper; enough even to outlast the utmost possible limits of its duration! Reliable statistical estimates have shown that the supply of copper in Germany in the possession of private owners, and in forms which will enable it to be dispensed with if necessary, amounts to two million tons in round figures.—*The Ironmonger.*

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C. N. MANFRED.

Sworn to and subscribed before me this 20th day of Sept., 1915.

(SEAL)

JOSEPH R. FRITH.

Notary Public Kings County, No. 42; Certificate filed in New York County, No. 46; Kings County Register's No. 6037; New York County Register's No. 6115.

My commission expires March 30, 1916.

NIAGARA FALLS SECTION ELECTROCHEMICAL SOCIETY

The November meeting of the Niagara Falls Section of the American Electrochemical Society was held Wednesday evening, Nov. 10, at the plant of the Niagara Falls Power Co., Buffalo Avenue, Niagara Falls, N. Y.

The subject of discussion was "The Electric Furnace in the Non-Ferrous Field," the speakers scheduled being F. A. J. FitzGerald of the FitzGerald Laboratories and W. M. Corse of the Titanium Alloy Mfg. Co., both of Niagara Falls.

The program was, however, changed somewhat owing to the presence at the meeting of Dr. H. W. Gillett of the United States Bureau of Mines, Ithaca, N. Y., who attended in a purely unofficial capacity because of his interest in the subject, and was called upon by the presiding officer, F. A. Lidbury, to present the opening address.

Dr. Gillett, responding, reviewed the history of the electric furnace in this particular industry. He stated, that up to the present the electric furnace had not succeeded in operating with the economy of the fuel-fired furnaces with which it must compete; that unless some new development occurred, the probability was that it never would; therefore, as far as he could see, the only chance of the successful application of this method of melting lay in turning out a superior product, due to the possibility of melting in a neutral or reducing atmosphere in a more or less air-tight furnace, by which means the melting loss might be lowered and the percentage of defective castings in the foundry lessened, which, together with the greater convenience of operation and the saving effected by eliminating handling of fuel, might offset the greater cost of the electric method of generating heat.

W. M. Corse, the next speaker, treated the subject from the standpoint of the manufacturer. He illustrated on the blackboard the various types of brass melting furnaces in successful operation and outlined the conditions under which the electric furnace would have to work to compete with them. He stated that the apparently crude, old-fashioned coke-fired natural draft furnace had many admirable features in

that its construction was very simple and it produced metal of such high quality that it was as much in favor now as at any time in the history of the industry.

He was followed by F. A. J. FitzGerald, who discussed various types of electric furnaces that had been used for melting non-ferrous metals, and illustrated then by the aid of lantern slides. He stated his conviction that if the electric furnace was ever to be successfully adapted to the non-ferrous industry, the question of cheapness in melting would have to be lost sight of for a time, because existing types of furnaces not being designed to meet the peculiar requirements of this field, it would be strange if some modifications would not have to be introduced.

This had been the history of the steel industry, in which field the electric furnace was now operating efficiently, while when first applied it was in the nature of a costly experiment.

New Granular Resisting Furnace

The electric furnace would have to be adapted to the special needs of the art, and he saw no reason why this could not be done; in fact, he believed that a granular resistance furnace which had been developed in the FitzGerald Laboratories, and had been tested on a commercial scale over a period of several months, could be developed into a very successful melting medium for brass foundries. A ground plan of this furnace was shown on the screen, but no extensive description was given.

The furnace is adapted for crucibles and consists of a round melting hole with sealed bottom, with provision for leaking metal, and a fire brick cover over the hole, resembling in a general way the ordinary coke furnace. Mr. FitzGerald stated that the furnace was not hard on crucibles, as old crucibles from coke-fired furnaces had seemed to take on a new lease of life when used in this type of electric furnace.

The next meeting of the Section, it was announced by A. T. Hinckley, secretary, will be held in Buffalo some time in December.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets first week in June, 1915, at Dayton, O. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES

Bridgeport—Meets on the third Friday of each month at 260 John Street, Bridgeport, Conn. Secretary Nelson Barnard, 858 Howard Avenue, Bridgeport, Conn.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, S. Wroblewski, 1486 Elmwood Avenue, Buffalo, N. Y.

Chicago—Meets fourth Saturday of each month at 8 P. M. at Western Building, Randolph and Michigan Avenue. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Avenue, Cincinnati, Ohio.

Cleveland—Meets last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Avenue, Cleveland, O.

Dayton—Meets first Wednesday of each month at Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 First Street. Secretary, E. E. Miller, 543 Townsend Avenue, Detroit, Mich.

Indianapolis—Meets last Saturday of each month at the Denison Hotel. Secretary, Arthur Nelson, 1617 Shelby Street, Indianapolis, Ind.

Milwaukee—Meets first Friday of each month at Eagles Hall, 137 Second Street. Secretary, E. C. Yaeger, 962 Ninth Street, Newark, N. J.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 West Madison Avenue, Irvington, N. J.

New York—Meets second and fourth Friday of each month at 258-262 Pearl Street, New York City, at 8 P. M. Secretary, Wm. Fischer, 345 East 23d Street, New York.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Rochester—Meets second and fourth Friday of each month at University of Rochester. Secretary, C. V. Haring, 603 Dewey Avenue, Rochester, N. Y.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, F. Rushton, 4405 Blair Street, St. Louis, Mo.

Toledo—Meets every Wednesday at Toledo University. Secretary, James E. Nagle, 209 Navarre Avenue, Toledo, Ohio.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Society Notes

The regular monthly meeting of the New York Branch of the American Electro-Platers' Society was held at 258 Pearl Street, New York City, Oct. 22, with President Reama in the chair.

After the regular order of business the laboratory committee continued their lecture on the making and analyzing of a silver solution, showing the simplest method of finding the free cyanide content.

The regular meeting of the Cleveland Engineering Society, Nov. 9, discussed "The Future of the Engineering Profession," a paper on the inter-relations of engineering and technical societies, by E. H. Whitlock and A. J. Himes, ex-presidents of the society.

At a special meeting to be held Nov. 23, "What the United States Weather Bureau in California is Doing for the Benefit of the Engineer," by W. H. Alexander, local forecaster for Cleveland, will be the paper of the evening.

As a result of conferences by the special committee empowered by the American Foundrymen's Association and the American Institute of Metals, to select the time and place for the 1916 foundrymen's convention, it has been decided to meet in Cleveland during the week of Sept. 11.

The annual exhibition of foundry equipment and supplies, to be held concurrently with the meetings of these organizations, will be conducted under the auspices of the American Foundrymen's Association and the American Institute of Metals. This decision was reached after mature deliberation and represents the unanimous action of the members of this special committee. It also has been approved heartily by J. S. Seaman, Seaman-Sleeth Co., Pittsburgh, past-president of the American Foundrymen's Association, and Jesse L. Jones, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., president of the American Institute of Metals, with whom the members of the special committee met for counsel and advice.

◆

The present paper is more than \$1 worth.—John F. Nestor.

TRADE NOTES

The Acme Die-Casting Corporation in Brooklyn, N. Y., is enlarging its plant after its first eight months of business, also increasing its capital to \$200,000. The new space under contract will give them opportunity to accept many orders they could not previously welcome.

The H. W. Johns-Manville Company, Madison Avenue and Forty-first Street, New York City, has taken over the entire production and sales of the Victor Brass Works, New York City, manufacturers of plumbing fittings.

The United States Smelting & Aluminum Co. of New Haven, Conn., has opened a branch office in Detroit at 830 Penobscot Building. This is as a convenience to customers and to accommodate increasing business.

Platinum is being superseded as a necessary metal in the electrical industry, in dentistry and to a considerable extent in jewelry, according to a report on platinum issued by the United States Geological Survey.

The Dutch Government has prohibited any further exodus of metal workers to England. Early in the war large numbers of Dutch workmen in metals went to Germany, attracted by the high wages offered in the munitions factories.

The Akron (Ohio) Aluminum Co. has been incorporated with \$10,000 capital. W. C. Washburn, George F. Andrews, H. W. Heckman and John Dildine, incorporators.

The Rose Metal Products Co., Glen Ridge, N. J., has been incorporated. Chemical products will be made.

A thief at the San Francisco Exposition broke into the exhibit of Baker & Co., and among other booty carried off the largest piece of platinum ever mined. The nugget was considered a treasure.

The strikers at the du Pont powder works, workers in sheet metal in one of the industries of the corporation, have returned to work.

The International Silver Co. and its workmen are still at odds over the question of wages.

George Belchic of the State Chemical research laboratories at the University of Kansas has invented a machine which will produce lead and zinc in commercial condition from material heretofore considered waste. After a year of experimenting, Mr. Belchic has announced that by mixing the waste product or "climes" with water and a little oil, and rotating the mixture, a froth containing the lead and zinc materials ready for the smelter will come to the surface.

The Waterbury Metal Wares Co., Waterbury, Conn., has been incorporated with capital of \$50,000. It will occupy a plant 80 x 100 ft., three stories, formerly used as a pattern storage building by the Waterbury-Farrel Foundry & Machine Co. The factory will be equipped for the manufacture of a general line of metal goods, but the main product will be special electric lighting devices and electrical specialties.

In October, the property and business of E. I. du Pont de Nemours Powder Company of New Jersey was sold and transferred to E. I. du Pont de Nemours & Company of Delaware, a corporation organized for the purpose of taking over and carrying on the business.

The new company will carry out all contracts of the old company, there being no change in the personnel or methods of handling the business. It will issue capital stock to the amount of \$120,000,000.

The new corporation bears the name of the original Delaware concern established in 1802 by E. I. du Pont de Nemours. The return to the original name is a tribute to the founder and emphasizes the long establishment of the business.

The incorporation was made in Delaware because Delaware was where the business originated and the main offices are located in Wilmington.

The chemical branch of the business of the concern has entered many industrial lines and further extensions are inevitable.

QUESTIONS AND ANSWERS

All inquiries are answered in the order received and the answers published in the next regular issue whenever possible.

Aluminum Skimmings

QUESTION No. 138.—We have on hand a large quantity of aluminum skimmings which we would like to be advised how to use in the cheapest manner possible. Please inform us how we can reduce these skimmings.

ANSWER.—If the skimmings are in the form of a dust containing no metal, the only thing that can be done with them is to throw them away, but if, as is usually the case, they contain much entangled metal, first melt a bath of aluminum in the bottom of the crucible and then add the skimmings from which the dust should have been screened. When the skimmings are melted into a mushy mass, add a piece of zinc chloride the size of a walnut, and stir well. This will free the entangled aluminum from the dross, and after the metal has ceased smoking the pot can be removed and the metal be poured into ingots. The dust-like skimmings consist largely of alumina, which can never be “reduced,” and is valueless. The use of chloride of zinc as a flux will prevent the accumulation of these skimmings.

Casting vs. Stamping

QUESTION No. 169.—We are re-designing a machine having a number of supports heretofore stamped out and bent up in order to provide a base for screwing same in position. We have found it very difficult to have all these supports bent so that the bearings will line up within 1/1000 when they are screwed into position, and it has occurred to us that the bending dies are not properly used, or else brass stampings cannot be bent accurately, and it might be advisable to use castings in their place. Will you kindly give us your opinion on this point?

ANSWER.—The bending dies are either inaccurate or else they are not properly used as you suggest, as there is no rea-

son why brass stampings cannot be bent accurately. We are of the opinion that brass castings would be far more troublesome than the stampings and not as accurate, unless they were made in steel molds. We would not recommend the castings as a substitute for stampings.

Cast Aluminum Pots

QUESTION No. 162.—Please inform us of a suitable formula to use in making cast aluminum cooking utensils.

ANSWER.—Any of the following formulas can be used the alloys containing zinc being the cheaper, but somewhat more difficult to cast successfully.

- 1. Aluminum 92 per cent
Copper 8 per cent

Add the copper to the aluminum in the form of a hardener containing 50 per cent aluminum and 50 per cent of copper, using 16 per cent of hardener to 84 per cent aluminum, melting aluminum and hardener together.

- 2. Aluminum 82 per cent
Copper 3 per cent
Zinc 15 per cent
- 3. Aluminum 70 per cent
Copper 3 per cent
Zinc 27 per cent

Try Blaming the Sand

QUESTION No. 170.—We are forwarding for your inspection a piece of manganese bronze cut from a casting we have made. You will note it is discolored in spots and shows spongy holes. We melt the metal in a crucible oil furnace, and keep it covered during the time of melting, but are at a loss to decide what the cause of the difficulty may be. We would esteem it a favor if you could inform us.

ANSWER.—The difficulty is caused by some flux that you are using on the metal during the melting period. This forms a very fluid slag that gets into

the castings with the metal and causes the defects you mention. If this slag forms during the making of the alloy, some sand should be thrown onto the metal to thicken the slag so that it can be skimmed off. Charcoal is the best cover for manganese bronze. There is a possibility, of course, that the spots may be caused by some fusible constituent in the molding sand, and if there is no slag on the metal when ready to pour, blame the sand, and try a different kind.

Cheap Brass Alloy to Stand Bending

QUESTION No. 172.—We are desirous of making a cheap brass alloy to stand much bending after casting. We use standard rod ends and turnings, and pour in green sand molds. The castings have an average thickness of 5/16 in., round or oval. We add about 8 lb. of lead to each hundred pounds of metal. About 25 per cent of the castings break on bending. Some fractures are spongy, others are fine. Can you suggest a remedy? Before pouring we add the lead and 1 oz. of aluminum to make the castings run well.

ANSWER.—The metal is too heavily leaded to bend to any great extent, and the remedy is to omit the lead addition. The lead does not assist the metal to run, it merely cheapens the metal, but this advantage is more than offset by the broken castings. Continue the use of the aluminum and omit the lead, and if this does not remedy the difficulty, add 10 per cent of copper to the scrap metal.

Rolling Hard Brass Wire

QUESTION No. 176.—We have on hand some hard brass wire turnings which we are melting for stamping purposes, and we are having considerable trouble rolling this material as it is very brittle. Could you suggest a suitable alloy to mix with it so that it would become workable?

ANSWER.—We would suggest an addition of copper, commencing with 10 per cent copper; for instance, 90 lb. of scrap and 10 lb. of copper could be tried first, and, if still too brittle, increase the amount of copper to 15 per cent, and so on until a suitable mixture is reached. The proper way to work up this material would be to run down a heat of 100 lb.

and take drillings from several of the ingots, mix them thoroughly and have an analysis made. This would enable us to advise with certainty how to use the material. In the absence of such an analysis the best mode of procedure in using the turnings is as outlined above.

Slack Vienna Lime

QUESTION No. 156.—We have about 100 lb. of Vienna lime composition that has become damp and powdered. Could you give us any information as to what we should use as a binder for same, that we may use it.

ANSWER.—After Vienna lime has become slack it is almost impossible to bind it in such a manner that it can be used for polishing again. It might be used as an abrasive in automatic tubbing machines.

Cost of Cobalt Plating

QUESTION No. 161.—Could you give us information about cobalt as compared with nickel plating. We desire price, solution against solution, up-keep, price of anodes, length of service, etc. A full line of information as to comparison of cobalt against nickel plating will be appreciated.

ANSWER.—The price of cobalt anode is \$2.50 per pound against 50 cents per pound for nickel. The cost of up-keep will run from eight to twelve times as much as for nickel. The cost of production will be considerably more from a cobalt solution. As to wearing qualities the two finishes are about the same.

Information concerning cobalt plating will appear as a series of articles in near-future issues.

Tinning Nose Sockets

QUESTION No. 163.—In tinning nose sockets for 4.5 high-explosive shells it is necessary to tin the inside nose socket without interfering with the thread. I want the best method to do this. We may either nickel-plate or tin, but the management seems to think tinning would be cheapest. I am operating a nickel tank, but am not familiar with tinning.

ANSWER.—We are of the opinion that a nickel-plate will prove cheaper and more satisfactory than the use of the

tinning process. The tin would be almost certain to interfere with the proper working of the thread.

Burnt-In Finish

QUESTION No. 164.—We are considering contract for screws finished like sample sent. What is this finish?

ANSWER.—The finish on the screws is known as the "burnt-in" finish. The method of applying the finish is to give the screws a little cyanide of copper plate, then heat in a muffled furnace until the copper is oxidized black, and becomes burnt into the surface of the iron.

What Causes Anodes to Coat

QUESTION No. 165.—What causes silver anodes to cover with a dark brown coating? By shaking, at times the coating removes itself and settles in bottom of tank as a sludge. Sometimes have to remove coating with a cyanide solution. Silver solution stands 8 deg. B. and carries nearly 3 oz. silver; use 1 to 1½ volts and get a good, heavy white deposit.

ANSWER.—Having the anodes turn dark brown or black is a common trouble where the solution is made with chloride of silver. If your solution is quite old, strip the metal out by using carbon anodes, then make a new solution, using cyanide of silver instead of the chloride. If the solution is in good condition otherwise, the addition of a good grade of cyanide will prove beneficial.

Formula For Nickel Solution

QUESTION No. 166.—Please tell me how to mix a good nickel solution and keep it; also when plating brass what is the best method of keeping nickel solution bright?

ANSWER.—The standard formula for a nickel solution to be used for plating brass is as follows:

Water	1 gal.
Double nickel salts.....	8 oz.
Single salts.....	2 oz.
Epsom salts.....	6 oz.

If a very white deposit is desired, 2 oz. of boracic acid per gallon may be used.

Unsatisfactory Plating Explained

QUESTION No. 167.—Under separate cover we have mailed a pie knife blade

which has plated very poorly, as you can see. We would appreciate your criticism as to the reason for it coming like this. This does not happen oftener than couple of dozen to gross, and all are apparently treated and handled in same way. Nickel silver articles plated in the same tank come uniformly good, although at times we have a somewhat similar condition, which makes us think it is in the solution. I find that carbon bisulphide has just been added for brightening, and whether that is the cause or not you are probably able to judge.

ANSWER.—The unsatisfactory plating on pie knives is not caused by any fault in the solution or in the preliminary cleaning operation, but by the manner in which they are strung up or racked. Whenever two pieces of work, especially articles made from steel, hang too close to each other in the solution the hydrogen given off from one has a tendency to burn the plate of the one nearest the anodes. We feel sure that if you keep your negative rod in motion by a mechanical means you will have no more trouble with hydrogen scars.

Reduce the Voltage

QUESTION No. 171.—Please say what causes my alkaline copper solution to plate streaking, taking on a discolored look after taking from solution. The oxidizing does not take well, and comes off. It stands 13 B° hydrometer, anodes are clean before plating, but turn green. The black nickel plates smut, and when brushed have a steel look.

ANSWER.—The trouble with your copper plate is caused by the use of a too high voltage or too little free cyanide in the solution. We would suggest reducing the voltage, and if the anodes still turn green after being in use, add cyanide until they work slightly dark, but clear up as soon as the current is cut off. The black smut from the nickel solution is caused by a too high voltage.

Cleaning Brass Work

QUESTION No. 168.—We are anxious to secure information regarding the best methods for cleansing brass work as turned out in automatic screw machines. In all probability we shall increase our equipment for this department of our

work, and any information that you can give us relative to processes that have worked out most successfully, or references to companies which would be in a position to give us an up-to-date equipment, will be sincerely appreciated.

ANSWER.—The use of various soap solutions for lubricating screw machine work is fast replacing the use of mineral oils. The solution most generally used is a strong solution of Castile soap to which enough olive oil has been added to prevent foaming. To clean articles from the soap solution it is only necessary to dip them in hot water and dry in sawdust. When oil is used, the excess should be removed from the articles by tumbling them in sawdust, then finishing by dipping in gasoline and drying under a hot blast.

Silvering Glass

QUESTION No. 174.—Can you inform us respecting a satisfactory solution for the deposition of a silver film upon a convex glass surface? We imagine the method by which the silver film is obtained on the mirrors used in automobile acetylene headlights would be satisfactory. We would like to use the solution cold, if possible. A method of cleaning the glass preparatory to the reception of the silver film would be quite acceptable, also. We are using, for our silver film deposition, an ammoniacal solution of silver nitrate with an aldehyde for the reducing agent, but with uncertain results, the exact cause for which we are at present unable to ascertain.

Has the "gun" method of depositing a metallic film, in the initially molten state, upon a surface, any immediate practical value? We would be pleased if you could give us the addresses of the manufacturers of this apparatus.

ANSWER.—We think your trouble is with the cleaning of the glass rather than with the formula for precipitating the silver. The glass should be washed with gasoline, then with a strong solution of an alkaline, such as caustic potash, then rinsed thoroughly and dipped in a solution containing 4 oz. of muriatic acid and 2 oz. of chloride of tin, per gallon. The tin dip causes a uniform reduction and precipitation of the silver and

will prevent peeling. The Schoop process is the invention of M. U. Schoop, a Swiss engineer.

Sherardize for Rust

QUESTION No. 175.—We have been having considerable rust on steel parts which we have first plated in a cyanide copper solution and then heavily nickelled. We have been told that we would not have this trouble if we allowed these parts to "age" after coppering and before nickeling; i.e., if we would allow them to stand for a more or less prolonged period between the coppering and nickeling operations, we would not have trouble from rust.

Will you give us your opinion as to what bearing the ageing process has, if any?

ANSWER.—Allowing the articles to stand between coppering and nickel plating would only increase your trouble with rust. The only certain way of overcoming the rusting would be to either sherardize or galvanize the articles before copper plating. Articles that have been sherardized or galvanized can be nickelled direct without the use of a copper plate, and articles are entirely rust proof.

Battery Carbon

QUESTION No. 182.—We would like to inquire of you if the carbon that comes from dry battery cells has any commercial value either for metal or a paint market, we clean batteries and extract the zinc from the cells.

ANSWER.—It has none. To make the cell it is mixed with other ingredients and its value as carbon is exhausted. The carbon battery plugs imbedded in the mixture are also worthless for similar reasons.

Try Muriatic Acid

QUESTION No. 159.—We are working an alloy (white gold) composed of 583 parts fine gold and 419 parts 20 per cent German silver, and find in "boiling out" in ordinary pickle, six parts water to one part sulphuric acid, that the work turns red. Is there any formula you could suggest that will not discolor this material?

ANSWER.—Would suggest that you try a weak solution of muriatic acid.

A Successful Business—And Why

As the story of a successful man is always one of interest if not of inspiration to others, so the story of a successful business concern, which is simply an organization composed of a number of successful men, has a good deal of human interest to it.

In the electroplating supply business, one of the most notably successful concerns is the Munning-Loeb Co., whose main offices and factory are located at Matawan, N. J. Although this concern

most of the problems are of an electrical nature.

A representative of the BRASS WORLD recently visited the company's plant at Matawan, N. J., and was very much impressed with the excellent manufacturing facilities and the character and extent of the business being carried on there. The plant at Matawan is located on a tract of land $4\frac{1}{2}$ acres in extent, situated on the New York and Long Branch R. R. The main building is three stories in height, 200 ft. in length



Main Office and Works of Munning-Loeb Co., Matawan, N. J.

is less than five years old, it has been very successful almost from the beginning and during the few brief years of its existence, has built up a business which is truly remarkable in many ways. As an indication of this we learn that although the month of June is generally one of the poorest months of the year in the electroplating supply business, the amount of business done by the Munning-Loeb Co. during June of this year exceeded that of any preceding month in the firm's existence.

The secret of success of this firm may be said to be entirely due to the character of the men at the head of it. Mr. A. P. Munning, who established the business was for many years general sales manager of the Cutler-Hammer Mfg. Co., one of the largest manufacturers of electrical apparatus in the country, while Mr. C. E. Watrous, who has been associated with Mr. Munning for several years was also formerly with the same concern. It will thus be seen that each of these men has had the advantage of an unusually wide and varied business experience and the fact that this was in the electrical line is significant, because in the electroplating supply business of to-day,

and 50 ft. in width and has a total floor space of 30,000 ft. There are several other buildings, including the foundry for the casting of anodes and a building devoted to the manufacture of plating compounds and carbonate of copper and zinc. A feature especially worthy of note is the laboratory, which is in charge of an experienced chemist and is completely equipped for the testing of raw materials of all kinds, as well as the finished products of the company. As a result of the systematic method of testing of materials employed, the products of the Munning-Loeb Co. have won an enviable reputation for being as near absolutely uniform in quality as it is possible to make them.

Ever since the organization of this business, the aim of Mr. Munning has been to do business on a strictly business basis, to furnish a line of products of the highest quality and to sell them at prices which would allow a fair margin of profit. In a business such as this, where the margin of profit has usually been extremely low, the most important thing is to know the exact cost of manufacture of every article. In order to do this, a complete cost system was installed.

The products of the Munning-Loeb Co. comprise everything in the line of electroplating and buffing apparatus and supplies. Lack of space will prevent more than a brief mention of some of these. Their line of Optimus electroplating dynamos are meeting with general favor in the trade and this department of the business is unusually active at this time. Among the larger orders on hand might be mentioned one for two 5000-amp. motor-generator sets, which will complete an installation of 30,000 amp. in six similar units for a large electro-galvanizing plant. Also an order for two 3000-amp. units and several smaller machines. Optimus dynamos are made in a large variety of sizes, both single and multiple voltage system.

The buff department of the factory is not only unusually interesting, but a very busy department. In fact, the writer happened to visit the plant when it was closed down to take the semi-annual inventory, but in spite of this fact the buff department was running at full blast on account of the press of orders on hand. A large part of the output of this department is the well-known Triplex buff which is a radical departure in buff construction. This buff derives its name from the fact that tests have proven that it will do about three times as much work as the ordinary loose disc buff.

This buff is made up of circular discs of cloth, folded, by halving and quartering, so as to form a triangular pocket. These pockets are arranged around a common center and overlapped. By means of this construction the warp and woof of the cloth runs directly into the body of the disc and when in use the threads wear out instead of pulling out. The claim is also made that the folds act as pockets, which take up and hold the composition, thus adding to the efficiency of the buff and affecting a saving in the amount of composition used. One of the features of the Triplex buffs is that when worn out they may be returned to the factory and re-made into new ones, the same size as the original buff. Two worn down buffs are used to make one remade buff. An interesting point in this connection is that the actual cost of these buffs to the user, particularly in the larger sizes and in the higher

weave materials, is brought down below that of ordinary loose buffs.

In the line of compositions we understand that the company is predicting something quite startling in the near future, an announcement of which will be made shortly. The company's business in anodes this year has been double that of any previous year. The two-bar construction is becoming widely adopted, while the demand for M. L. high purity anodes is steadily increasing. The anode foundry, which is in a separate building, is equipped with two large oil-burning furnaces especially adapted to this work. No scrap whatever is used in the manufacture of anodes, which are made entirely of new metal.

The latest product of the company is their No. 6 cleaning compound, which has been placed on the market as the result of many years of experiment and painstaking research. We are informed that one of their customers, a large manufacturing concern handling among other things large quantities of steel pieces, have been using an electric cleaner and then rinsing and repeating this operation three or four times, requiring a total of 10 to 12 min. A trial of No. 6 cleaner under exactly similar conditions, cleaned the material in one emulsion of 45 sec. The brush department is also well worthy of note. The entire line of M. L. brushes is made in their own factory and under their own supervision. The line of these brushes is quite extensive, embracing every type of brush used around plating and polishing rooms, foundries, etc. Another feature of interest is the new plating barrel, recently placed on the market, which they claim has a number of distinctive features to be found in no other device of this kind. This machine is so arranged that the handling of the cylinders containing the material to be plated is facilitated to the greatest possible extent.

In the conduct of the business of the Munning-Loeb Co. the idea of "service" is first and foremost and in visiting their plant at Matawan and meeting the various men in charge, one cannot fail to be impressed with the fact that this concern is easily "making good" along these lines.

"Keep your eye on the Brass World"

A Soap that Cleans Without Corroding

In cleaning metal surfaces preparatory to plating and lacquering, it is important that the cleaning preparation employed should not corrode or tarnish the metal, as this means rebuffing and adds unnecessarily to the cost. The manufacturers of New Process soap claim that it will remove oil, grease and dirt from metal surfaces and leave them bright, regardless of the length of time the articles may be left in the bath.

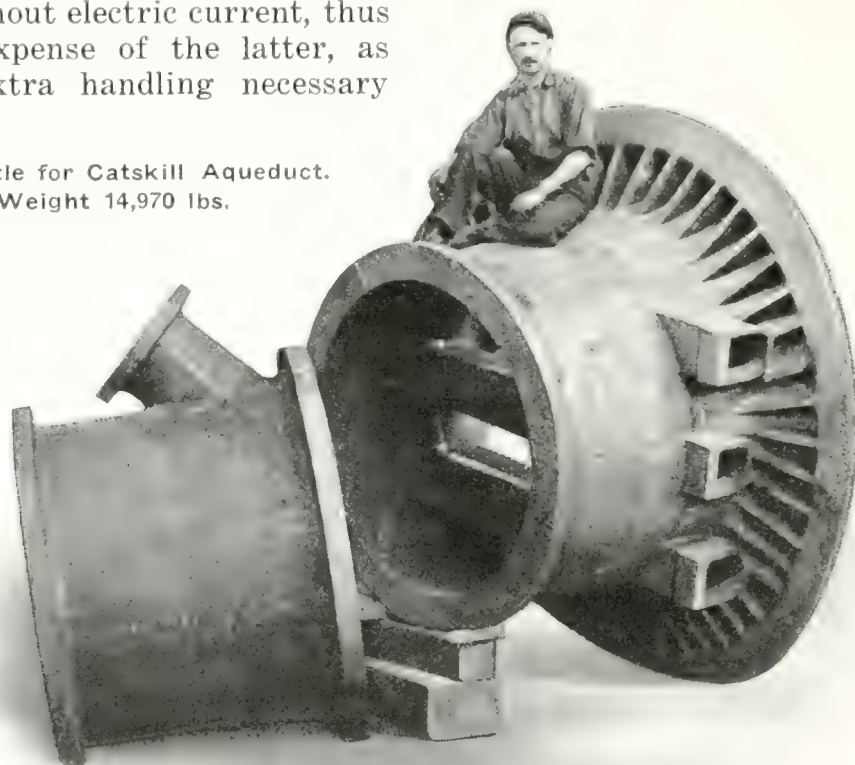
New Process soap is used in a still or dip tank without electric current, thus avoiding the expense of the latter, as well as the extra handling necessary

A Book on Manganese Bronze

"High Grade Bronzes," a book issued by the American Manganese Bronze Company, Holmesburg, Philadelphia, Pa., contains much information of interest and value to engineers and users of high tensile bronzes.

This book, which can be obtained free on request, contains many illustrations of large castings produced by the company, such, for example, as one of the six 72-in. waterway shaft caps (body weighing 24,000 lb., cover 4800 lb.), made for

Blow-off Nozzle for Catskill Aqueduct.
Total Weight 14,970 lbs.



where the electric process is used. This soap is very effective for removing mineral oils and vegetable fats from brass castings and for all cleaning purposes incidental to plating and lacquering. It gives unusually quick results in cleaning, the ordinary run of work being thoroughly cleaned in about 30 min.

Among the large concerns that have been using New Process soap with excellent results is the National Cash Register Co. of Dayton, Ohio, who have used over 150,000 lb. during the past few years. Any interested parties can secure full information regarding this soap by addressing the manufacturers, Fansher Bros., 18-24 Benton Street., Dayton, Ohio.

the Catskill Aqueduct; blow-off-nozzle, total weight 14,970, used in connection with the gate valve made by them for the same works, and an illustration of which is shown herewith.

Considerable space is devoted to Tensilite, a high tensile bronze, which is claimed to be the strongest on the market, as strong as nickel steel. Tensilite is a homogeneous alloy of close even texture, and can be cast, forged, rolled or extruded. It is non-magnetic, non-corrosive, has machining qualities about equal to nickel steel, and possesses good anti-frictional properties. Tensilite is attracting much attention from the engineering profession throughout the country, as service has proved it so par-

ticularly well adapted for gears, bridge discs, armature discs, press bearings—in fact, where ever an anti-frictional metal of great strength is required, or where non-magnetic and non-corrosive metal is required.

Worm gears of Tensilite used in a Niles Bending Roll at the Navy Yard, Philadelphia, after a year and a half of severe service, showed practically no signs of wear, while the Link Belt Company, after an extended experience with this metal for the main bearings of a 500-ton Tenaute press, which were subject to a pressure of 500,000 pounds each, report that no signs of scoring or squeezing out showed, and that they believe that Tensilite is the only metal which they know of that would stand such enormous pressure.

The American Manganese Bronze Company manufacture every grade of bronze, but their specialties are Tensilite and manganese bronze, the latter have a tensile strength of 75,000 to 80,000 lb. per sq. in., 25 to 30 per cent elongation in 2 in., and an elastic limit of about 40,000 lb.

This company, which furnished hundreds of tons of bronze for the Catskill Aqueduct and the Panama Canal, have the largest melting capacity of any bronze foundry on the continent, due to which they are able to give most prompt service. They are especially well equipped for handling large castings, in fact this book would indicate that nothing is too large for them, while their testing and chemical laboratories afford them constant and accurate control of all their products both on physical and chemical properties.

Eclipse Air Brush Co. Move to Larger Quarters

In order to accommodate the rapidly increasing business of the Eclipse Air Brush Co. of Newark, N. J., it has been found necessary for them to move their offices and manufacturing plant into larger quarters. The new plant is located at 70 Orange Street, Newark, N. J., where they have about four times the floor space of their former factory, together with better manufacturing and shipping facilities.

In connection with the new location, special facilities have been provided for demonstrating their various spraying devices in any finish and with any material. Demonstrations may be made also with special materials furnished by prospective customers. A section of this department is shown in the accompanying illustration.

In order to maintain the high standard of quality for which the products of this company have been noted, facilities have been added for testing of materials used



A Section of Demonstrating Room

as well as the completed machines and every machine is now subjected to a thorough test under actual working conditions before it is shipped.

A large stock is kept constantly on hand so that prompt shipments can be made. This includes sprayers and compressors of the latest improved types, both water cooled and air cooled, and tanks having capacities of 20, 30 and 70 gal. each.

A new booklet has just been issued by the company describing their complete line of spraying apparatus, copies of which will be sent to any interested parties on application.

In connection with the new factory, facilities have been added for doing japaning and enameling for the trade and they are now doing considerable work of this kind under contract for manufacturing concerns in various lines.

The report of the Russian Copper Syndicate, "Medj," for 1914 shows that copper smelteries failed to reach their predicted output. Instead of exceeding that of the previous year by about 15,000,000 lb., the production decreased.

CLASSIFIED ADVERTISEMENTS

Advertisements for Situations Wanted, not exceeding 75 words, published free of charge for subscribers. Help Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars

For Sale

FOR SALE—One type S.H. 1500-amp. 6-volt Zucker & Levett & Loeb generator. Practically new, used only eight months and in excellent condition. Write Indianapolis Stove Company, Indianapolis, Ind.

SMALL electroplating outfit used two months. Address Box 9, care of Brass World, Edison Bldg., New York.

FOR SALE—Hanson Van Winkle Co. automatic plating tank, \$75. Address T. E. Bennett Company, 7 Beverly Street, Providence, R. I.

FOR SALE—Complete set of transactions of American Institute of Mining Engineers covering years 1893 to 1912, in first class condition at a special low price. Address Box 1137, Brass World, Edison Bldg., New York City.

FOR SALE—Modern equipped polishing and plating plant centrally located in busy Detroit. Have operated this plant successfully for four years. Other business opportunities demand entire attention. Address Rex Jobbing Co., 64 Second Ave., Detroit, Mich.

Bone and Ivory Chips Wanted

WANTED—Bone and ivory chips or dust, waste of manufactured articles of bone and ivory. Send prices and samples, also quantities produced. Will pay cash for the right materials. Address Box 14, Brass World, Edison Bldg., New York.

Help Wanted

SALESMAN—Concern in the West making plating and tumbling machinery and selling plating supplies, wants first-class salesman for the Eastern territory. Must be a practical plater and able to

demonstrate the apparatus. Address Box 501, Brass World, Edison Bldg., New York.

WANTED—Brass foundry foreman; one who is familiar with plumbing supplies. Must be up to date on match plates and molding machines; mixing metals; and get out production at minimum cost. In reply state experience, salary expected and reference. Address Box 1138, BRASS WORLD, Edison Bldg., New York.

Situations Wanted

FRENCH MOULDER — Ex-foreman large art bronze foundry in Paris desires position. Can accomplish rapidly the most difficult work. Will take contract, if desired; also thoroughly experienced in gold and silver work. Speaks little English. Address Box 1135, Brass World, Edison Bldg., New York.

EXPERIENCED FOREMAN PLATER—Desires situation. Understands plating, polishing, lacquering, oxidizing. Can also work barrel plating, ball burnishing, and all kinds of tumbling. Member Am. Soc. Electro-Platers. Address Box 1136, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Wants to change position. Best references, 19 years' experience. Can handle all usual work in all metals, also stove, plumbing supplies, trunk hardware and jobbing work. Can handle workmen, day or piece work. Am at present in charge of 3 departments. Address Box 1134, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Who needs a foreman plater of seventeen years' actual experience in all popular finishes in gold, silver, nickel, copper, brass, bronze, tin, lead? Who has hardware that must

be produced economically? Who has something hard to do in the plating line and is willing to back up a competent man in fitting up a plant to defy competition? Who has die-castings to plate in any metal with not more than five per cent loss? I will take your hardest proposition, and if it can be done I will do it. I am for sale. Address Box 1031, Brass World, Edison Bldg., New York.

MOLDMAKER—Twenty years' experience in designing and modeling trimmings for britannia hollow ware, chasing and fitting molds and dies; A1 on toilet ware, dies and forces. Address Box 1027, Brass World, Edison Bldg., New York.

POSITION WANTED by a first-class brass foundryman, experienced in plumbers' supplies, valve work, builders' hardware and general jobbing. Address Box 1032, Brass World, Edison Bldg., New York.

NICKEL PLATER—Over 20 years' practical experience in plating, polishing and buffing. At present occupied, but desires position with manufacturing plant as superintendent; or foreman of the above-named departments; best of references. Address Box 1028, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Nineteen years' experience as plater, polisher, buffer, lacquerer and japanner; also good knowledge of chemistry. Am open for a position; can handle men to employer's advantage. Experienced in working on every solution known to the trade. Best results guaranteed. Will go anywhere in the United States. Best of references. Address Box 1030, Brass World, Edison Bldg., New York.

PLATER—A No. 1, steady and reliable; have a broad experience with a large variety of work, including on nickel, brass, copper, bronze and zinc, and a little silver and gold plating. Tinning; all kinds of oxidizing and lacquering. At present employed. Would make a change to good, reliable concern. Can handle piece or day work help to advantage. Address Box 1025, Brass World, Edison Bldg., New York.

PLATER—I understand plating, polishing, buffing, lacquering and oxidizing of all metals. Can also nickel plate sheet zinc and castings. Address Box 926, Brass World, Edison Bldg., New York.

PLATER—Married; fourteen years' experience at all finishes, gold, silver, nickel, copper, brass, bronze, oxidizing, etc.; make all solutions. Have had wide experience on various articles of manufacture. Steady and sober; quick worker. Will leave city, if permanent position. Address Box 922, Brass World, Edison Bldg., New York.

PRACTICAL PLATER — Foreman plater with electrochemical knowledge desires to connect with a reliable firm where his knowledge would be useful. At present employed as foreman of a plating, polishing and finishing department. Want to make change. Address Box 918, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Have twenty-two years' experience; can take charge of polishing and buffing departments; have good references; thoroughly up-to-date on all solutions and finishes; mechanical plating and polishing barrels; can handle help to advantage and show results. Address Box 921, Brass World, Edison Bldg., New York.

BRASS FOUNDRY FOREMAN—Wanted position as foreman or assistant in brass or aluminum foundry. Familiar with metal mixing machines and all up-to-date methods of molding. Wide experience; good references. Address Box 15, Brass World, Edison Bldg., New York.

PRACTICAL MAN — Understanding plating, polishing, buffing. Over twenty years' experience. Wants place as superintendent or foreman of departments named in a manufacturing plant. Best references. At present engaged, but desire to change. Address Box 12, Brass World, Edison Bldg., New York.

PLATER—First-class; steady. Can mix and run all solutions, barrel and still plating. Ball burnishing, etc. Desires to change. Moderate salary. Address Box 11, Brass World, Edison Bldg., New York.

Current Metal and Supply Prices

It is impossible in giving a list of current prices of metals and chemicals to do more than to furnish quotations which are approximately correct at the time of going to press. The prices of many of the items included below are influenced by war and other conditions which make them unstable at the present time.

New Metals

At the time of going to press it is fair to report an excited market that seems to be governed by speculative considerations rather than immediate requirements.

Copper is said to have been sold (a few transactions) running over requirements for the whole of 1916 at 18c. Generally there is a stronger feeling, but buyers seem to show no real confidence beyond the needs for the next three months. Second hands and dealers are reported as entirely out of the market. While having only small saleable stocks, they yet show no buying interest on a strong market. Prime lake is quoted at 18¼ to 18½c., electrolytic the same, and casting 18 to 18¼c. Buying is only hand to mouth.

Tin has been very feverish on reports first one way then another that have taken on the shape of news and speculative rumors. The latest is that the Suez Canal is closed to traffic and that cargoes will have to take the route via Good Hope. This increase in time of transportation is offset by less danger from submarine destruction to cargoes. We are over London's price in the market at present, and if London has tin to spare, it is thought some should soon be coming this way. Consumers seem at the moment to be a little panicky, and those having a surplus cannot sell, having bound themselves on the tin delivered under British regulations, to use only for their own requirements, and not under any condition to resell. Latest quotations are, city delivery (N. Y.), nominal at 44.00, December nominal, 43.00.

In spelter there seems to be a "corner" in London spot, and prices are being marked up, but the metal does not export freely, nevertheless, said to be due to the ocean freight situation, and the further fact that the prices apply only to spot. Locally, there seems to be more spelter on the market than there are buyers, especially in futures, and the first and second quarters of 1916 are quoted on offer at 14¼c. Dealers who were large buyers on the advance are among the sellers now; market firm, but less active on prompt quotations, 16.05 to 15.75.

Antimony appears to be developing a scarcity in spot because of good demand. Chinese and Japanese, 36.00 to 36.50, American, 35.50 to 36.00.

Old Metals

There seems to be an improvement in demand for all grades of metal, owing to higher quotations for new metals. Some think prices will go still higher soon owing to better demand. Lead, zinc and aluminum scraps appear to be the laggards, with copper and brass scrap prices stationary. The advance made by the lead trust had its effect on that metal in scraps and drosses. The flighty ideas as to price changes appear to have been most prevalent among the smaller class of dealers, who were almost shy of profit by the marking up process. This was noteworthy in zinc and aluminum scrap. Brass turnings are quiet, but composition scraps are firmer. Export trade is negligible. Light copper scrap holds at 13¾ to 14c., while composition copper has advanced about ¾c. since our last report. Heavy brass is 10¼ to 10½c., a slight decline from last month's report. No. 1 brass turnings are off a little, being held at 10½ to 11c. Composition turnings hold steady at 11½ to 12c. Brass clippings have held their strength at 12 to 12½c. New aluminum scrap continues to advance and is now 42 to 44, the old is held at 36 to 38. Lead scrap is 4½ to 4.60. Heavy red brass is at 12 to 12½c.

CHEMICALS

Acetone, pure 98-99 per cent. .40 lb.
 Acid, acetic, pure 30 per cent. .15 lb.
 Acid, arsenious (white arsenic) .10 lb.
 Acid, boracic (boric), pure .20 lb.
 Acid, hydrofluoric, 48 per cent. .40 lb.
 Acid, muriatic, 20 deg. .02½ lb.
 Acid, muriatic, c. p., 20 deg. .07½ lb.
 Acid, nitric, 38 deg. .05¾ lb.
 Acid, nitric, 40 deg. .06 lb.

Acid, nitric, 42 deg. .09¼ lb.
 Acid, nitric, c. p. .10 lb.
 Acid, sulphuric, 66 deg. .02½ lb.
 Acid, sulphuric, c. p. .07½ lb.
 Alcohol, wood. .55 gal.
 Alcohol, denatured .63 gal.
 Alum, burnt and powdered, technical. .20 lb.
 Alum, commercial .06 lb.
 Ammonium sulphate. .05 lb.
 Ammonia water (aqua-ammonia), 26 deg. .06 lb.
 Ammonia water, c. p. .10 lb.
 Ammonium carbonate, lump, C. P. .15 lb.
 Ammonium chloride (sal-ammoniac) .16 lb.
 Ammonium hydrosulphuret .25 lb.
 Ammonium sulphate .09 lb.
 Amyl acetate .4.40 lb.
 Antimony (fine powder) .lb.
 Arsenic, metallic .lb.
 Arsenic, white (acid arsenious) .10 lb.
 Bismuth, metallic .3.00 lb.
 Blue-vitriol .12 lb.
 Borax, crystals or powdered. .15 lb.
 Borax, powd., refined, bbl. .07¼ lb.
 Borax, lump, refined, bbl. .07½ lb.
 Borax glass .30 lb.
 Carbon bisulphide .20 lb.
 Calcium carbonate (precipitated chalk) .10 lb.
 Chrome-green, c. p. .26 @ .30 lb.
 Cobalt, metallic, pure and carbon free. .3.00 lb.
 Cobalt, black peroxide. .1.95 lb.
 Copper carbonate, dry. .30 lb.
 Copper, sulphate (blue-stone) .12 lb.
 Copper trisalyt .30 lb.
 Copper cyanide (technical) .1.00 lb.
 Cyanide, see Potassium cyanide. .40 lb.
 Dextrin .15 lb.
 Emery flour .05 lb.
 Emery, F F & F F F. .03 lb.
 Flint, powdered .25.00 ton
 Fluorspar .30.00 ton
 Fusel-oil .4.50 gal.
 Gold chloride .11.75 oz.
 Gold trisalyt .10.00 oz.
 Iron perchloride (110 lb.) .20 lb.
 Iron sulphate (copperas) .05 lb.
 Lead acetate (sugar of lead) .20 lb.
 Lead, red (pure) .15 lb.
 Lead, yellow oxide (litharge) .15 lb.
 Nickel and ammonium sulphate (double salts), 100 lb. .10 lb.
 Nickel carbonate, dry. .80 lb.
 Nickel, metallic .60 lb.
 Nickel sulphate (single salts) .20 lb.
 Nitre (saltpetre), see Potassium nitrate.
 Oil of vitriol, see Acid, sulphuric.
 Paraffin, high viscosity. .15 lb.
 Phosphorus .05 lb.
 Pitch .05 lb.
 Plaster of Paris, dental .05 lb.
 Potassium bichromate, c. p. .50 lb.
 Potassium carbonate .39 lb.
 Potassium cyanide chloride mixture. .23 lb.
 Potassium iodide .3.75 lb.
 Potassium permanganate .1.25
 Potassium, red prussiate. .2.50 @ 2.75
 Potassium sulphate (liver of sulphur) .20 lb.
 Pumice, ground .05 lb.
 Rochelle salts, U. S. P. .40 lb.
 Rosin, yellow .08 lb.
 Silver chloride, dry .65 oz.
 Silver cyanide .1.00 oz.
 Silver nitrate, crystals .45 oz.
 Silver trisalyt .24 oz.
 Soda-ash .05 lb.
 Sodium bisulphite .01¼ lb.
 Sodium carbonate (sal-soda), crystals. .00¾ lb.
 Sodium hyposulphite ("hypo") .03 lb.
 Sodium nitrate (technical) .10 lb.
 Sodium phosphate (technical) .09 lb.
 Sodium silicate (water-glass) .05 lb.
 Tin chloride .43 lb.
 Turpentine, spirits of .55 gal.
 Wax, beeswax, yellow .37 lb.
 Wax, carnauba .45 @ .47 lb.
 Whiting (ground chalk) .05 lb.
 Zinc, carbonate, dry .30 lb.
 Zinc, chloride .15 lb.
 Zinc, cyanide .1.00 lb.
 Zinc sulphate (technical) .12 lb.
 Zinc, (spelter) .16 lb.
 Zinc, trisalyt .28 lb.

The Brass World & Platers' Guide

Volume XI
Number 12



New York
December, 1915

A Monthly Journal Devoted to the Art of Refining, Alloying, Casting, Rolling
Founding and Electroplating of All the Non-Ferrous Metals and their Alloys

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"Keep Your Eye on the Brass World"

It is now nine months since the new management assumed control of this journal. At the beginning of the tenth month constructive progress has demanded the change which will be ushered in by the larger and "standard-size" of the BRASS WORLD, of which announcement was made last month; thus the new year will mark a forward step that means a larger volume of text, with scope for fuller illustration and at no increase in subscription price. Our advertisers will have nearly 75 per cent more space in which to make their messages to our readers more forceful and attractive. Such a step forward is too significant to pass without more than an announcement.

When the new management assumed control it was rather an unknown quantity to the trade and very naturally there followed a short period of "watchful waiting" to observe what would happen to the journal that had the prestige of Edwin S. Sperry as its foundation stone.

All change is somewhat disorganizing, particularly where it is a change of base as well as ownership, and it was not until after a few issues had made their appearances that the tide of approval set in towards the new management.

This was first made apparent by a very gratifying increase in the number of new subscribers, and what was even more encouraging, a splendid list of renewals, accompanied by expressions of good will that were a better reward than even the money. It demonstrated that the pace set by the founder of the BRASS WORLD was, at least, being maintained.

This is as it should be, but it is not enough nor does it measure up to the ideals of the management. Progress must mark improvement, and progress has to be a continuous effort, or it is not progress, hence our plans contemplate a publication that shall court favorable comparison with the best in class journalism. It will be easy for our well-wishers to note our achievement of this aim, as the standards exist in other trades—if not at present in the one which we cover.

Our effort is and shall always continue to be the gathering together in the text

pages all the best practical thought based on sound theories. We have already gathered together an able list of contributors, but our limit is confined only by the supply, known or yet to be developed, and we shall stop at nothing that will lend instruction and luster to our contributed articles. What prosperity is vouchsafed to us we shall share with our subscribers and contributors in a spirit of fair co-operation. Only by such means, as we view it, can we make the BRASS WORLD what its brilliant founder, Sperry, would have made it had he lived to continue his work.

Promise and performance may not always be convertible terms, but—

"Keep Your Eye on the BRASS WORLD."

The subject of plating with Cobalt is the present outstanding topic among platers if we may form a just conclusion from our correspondence.

So far as we know the very elaborate experiments conducted by the able men in charge of the work done in Queen's College, Canada, are, at least for the present, the most thoroughgoing data we have.

We begin in January to present as much as possible of the contents of the volume that contains their practical findings on the subject of Cobalt plating, a comparison being maintained with nickel. The articles will continue through several issues, and ought to be of much practical use to all electroplaters.

One of the earliest methods of making aluminum bronze was to reduce the aluminum directly from one of its compounds such as corundum by means of carbon, in the presence of copper in an electric furnace. The molten copper absorbed the aluminum, preventing the formation of aluminum carbide, and the resulting product would contain from 15 to 30 per cent of aluminum. This alloy was analyzed, its composition ascertained, and then remelted with the proper amount of copper to bring it to a standard percentage of aluminum. This method greatly resembled the early manner of making yellow brass by smelting together copper and calamine.

THE ART AND PRACTICE OF LACQUERING

Tested Methods in the Plating Room that Explain Application, Effects, Materials and Appliances

By FRANCIS A. SHEPHERD*

Part I. Theory of Colors and Application of Lacquer.

In the last few years a great change has occurred in the art of coloring metals, and new methods have affected the character of the finishes which have been in keeping with modern taste and the luxury of the times.

Some manufacturers have gone to a great deal of expense for the equipment to produce these modern finishes and color effects, but few have given the right consideration to the important operations which have the power of improving or destroying the effect desired.

This final operation is the lacquering.

The finish on the cheaper metal goods is what really makes them saleable, even if other parts of the work have been slighted, and as a result the appearance is good even if the quality of the base metal or workmanship is not there. A lacquer that has been especially adapted to the work has the power of increasing the beauty as well as the effectiveness of the finish. Due consideration must be given, of course, as to whether a lustre is required that will enhance the brilliancy of the underlying color either in the natural base or colored effects, or, on the other hand, whether it is to have a mat, or semi-dead finish, similar to the brushed and sandblasted grounds for the bright as well as the oxidized finishes.

Color is defined as a property of light which causes bodies to have different appearances to the eye. There are seven prismatic colors—red, orange, yellow, green, blue, indigo and violet. These are the prime colors and their combinations create all other colors. In the spectro-scope three tubes are focused on a triangular piece of glass in such a way that each tube points at an edge of the prism. One tube has a narrow slit in its outer end, through which a beam of light is admitted, which in turn is concentrated by a lens on the prism. Another tube has a fine scale on its outer

end which is reflected through the prism into the last tube which is a telescope, and by means of a candle or other light an enlarged image of the scale is seen. The light from the first tube passes through the prism and is dispersed into what is called a spectrum, which is examined by means of the telescope magnifying it. With ordinary candle light this spectrum is a continuous band of colored light, consisting of the seven prismatic colors, and similar to the rainbow.

The spectrum of an incandescent solid is a continuous band of colors. The spectra of gases are narrow, colored, vertical bars or lines, separated by black spaces. Each element which is a gas, or which can be vaporized, has its own bright line spectrum. The lines always occupy the same position, relatively, on the scale.

A potassium, sodium, barium and calcium salt, taken up on a loop in a platinum wire and moistened with hydrochloric acid, placed in a non-luminous flame of bunsen burner (so placed that the vapor will be reflected through the narrow slit in the first tube mentioned) will show on the scale reflected in the telescope red and violet for potash, yellow for sodium and barium several lines where the green and the yellow parts of the ordinary spectrum occur. The spectrum of sunlight has the familiar band of colors, but it is crossed vertically by many black lines having fixed positions. Assuming the sun as surrounded by very hot gases, being a glowing hot solid, it should give two kinds of spectra—continuous and the bright line. It has been proved that the vapor of an element absorbs the light of the same element when solid. Therefore, the solar spectrum (called an absorptive spectrum) indicates that the black spaces are caused by the presence of those elements that would naturally occupy those positions

*Member A. E. S.

on the scale. With the above in mind then: The color of any object depends on its power of retaining or rejecting certain constituent colors of white light. All colored objects reflect only the colors not absorbed. A body that absorbs all is black (the rays of light absorbed, of course). An object that absorbs all the rays partially but equally is gray, one that reflects all visible rays equally, white.

White light contains all the prismatic colors, but a mingling of blue and yellow rays will also give white, a mixture of blue and yellow paints or colors gives green. This is owing to the double absorption of the rays of light for the two colors, yellow and blue, and the reflection of the rays not absorbed. There are only three of the prismatic colors that are recognized by artists—yellow, red, blue—called primary colors because they cannot be formed by any mixture of any of the other colors. On the other hand, all other colors can be obtained by the proper mixture of these three colors. Secondary colors are a mixture of two primary colors; the mixture of three colors is tertiary, etc. Any two colors that are mixed and that reflect, or produce, white light are complementary. The complementary colors are orange Prussian blue, yellow and indigo blue, greenish-yellow and violet, and red and greenish-blue.

R. J. Wallace, instructor in physics at the Yerkes Observatory, University of Chicago, and inventor of a color filter used in photography, considered all the relations of colors, light rays, etc. The result of his research was a filter that entirely eliminates the ultra-violet rays and dims the other remaining spectral hues in proper proportion. By the use of this filter sharp and true color value is given to the negative.

Different Applications of Lacquer

A lacquer has also the same power. If sharp color relations are required it is obvious that a clear, colorless lacquer is required; again, certain finishes may require blending of the colors, at the same time keeping the proper relations. As an instance (considering the color only, not the lustre) in the brush brass

finish, as a rule a clear lacquer with heavy body is used. Lemon brass finish is obtained on the same base by the addition of a little green color added to the same lacquer, etc. These colors are obtained by dissolving analine colors in pure alcohol (or the thinner that is used for the lacquer), and just a little added and well stirred into the lacquer to mix it.

Next in importance to the lacquer is the method of its application; whether it is better to spray, brush or dip lacquer. This has to be determined by the character of the work to be lacquered, as some work naturally would adapt itself better to the dip process than to any other, there might not be enough lacquering to warrant the expense of the volume of lacquer required, therefore, brush lacquering would be best. Where there is much work to be lacquered, such as fire extinguishers, umbrella stands, large urns, vases, etc., or large work that is lacquered only on one side, there is no better method than the spray system of lacquering. Anything that can be brushed can be sprayed at a saving ranging from 10 to 60 per cent, notwithstanding the apparent extra waste of lacquer, and a superior result to the finish if properly applied.

If a brush lacquer is used, a lacquer is required that will flow evenly and be of good body and specially made for the finish (colored or natural) and the atmosphere to which it will be subjected.

To get the best results with brush lacquers use only the thinner supplied by the manufacturer for the grade of lacquer used. Only just enough thinner should be used to allow the lacquer to flow evenly and without danger of iridescent colors, still not too thick, or it will form runs or stop marks, and fill up the finely chased lines in the design of the object. It should not dry too quick, otherwise in taking up the excess of lacquer with the brush, brush-marks or streaks will be left. These streaks will give the same iridescent streaks that would be formed by too much thinner. For this reason also only the best camel's hair brush should be used, and one that is rubberset, otherwise the hairs will come out, due to the

pull of the lacquer, and the lacquered surface would be marred in removing them.

Dip Lacquering

The best kind of lacquering and also the surest is dip lacquering. Because it is so considered, the greatest percentage of the best class of goods is treated in this way. There is no danger of spots or thin streaks not being covered with lacquer, later to become discolored and iridescent. If a good grade of dip lacquer is used it can be thinned down (with its own thinner, of course) so as not to leave any runs or drips on the edges and corners. Any drip left would form either a lump or a dirty spot of green. The thinner a dip lacquer can be used without iridescence, the cheaper and more economical it will be. Such articles as watch fobs and advertising novelties, or other small work that is strung on wires and finished, can be dipped on the wires and dried in the oven on them. It is required, though, that any danger of water being carried into the lacquer is to be eliminated; work should also be clean.

Unless the lacquerer is an expert and has had a great deal of experience, and the volume of lacquer that would be required would be too large for dipping, spraying is by far the best and cheapest in both material and labor. There are no brush marks left, and a good even finish can be applied with very little experience that is superior to brushed work.

Spray Lacquering

The main point about spray lacquering is to get the proper spraying machine; one that is easily operated and can be controlled with one hand, simply constructed and easily cleaned and kept cleaned. To get the best results, the spraying machine should give a continuous stream of lacquer, and it should inextricably intermingle all the lacquer particles and blow them onto the metal surface in a firm, compact and lasting lacquer film.

The function of the air is to force the finely divided lacquer spray through the nozzle of the spray machine where it comes in opposition to atmospheric pressure of something like 15 lb. to the square inch. In overcoming this pressure the

stream spreads out like the beam from a searchlight, increasing in its volume proportionate to the induced pressure of air propelling it. Such being the case, the heaviest part (or body of the lacquer) occupies less unit space and, therefore, meets less resistance in proportion to its volume. The result is that there is a separation of the body from the volatile thinner of the lacquer and, both being finely divided, the tiny globules of the lacquer will partially set or harden; but if the work it is being applied to is too far from the machine the lacquer will be deposited in a nearly dry condition, and will be sandy or rough.

Depending on the size of the work and the nozzle of the machine, the distance for efficient operation lies between three and eight inches. The spray or mist should not be applied perpendicularly to the work, but should be delivered at an angle of about 45 deg. This will let the heavy body stick, and the mist of thinner glance off into the air as it would naturally do anyhow. The thinner is only added to lacquer to increase its fluidity, having absolutely no part in the final film other than to allow the body to cover more space in proportion to its volume.

The important points are therefore: No matter whether the lacquer is to be applied by dipping, brush or spraying, the thinner is only added to make the base or body of the lacquer cover more surface with as thin a film as possible, and still protect it from the danger of iridescence.

Lacquerers should use only the thinner specified by the firms who supply them for the grade of lacquer used. The bases of the different lacquers are not all the same even for the same manufacturer. Each of the substances used requires a solvent of its own. A mixture of bases requires a proportionate mixture of solvents (which are supplied as thinner) in order to make a homogeneous mixture. It is evident, then, that if these conditions are not obtained when reducing the body of lacquer (thinning) the resultant film of lacquer applied cannot be expected to be homogeneous, or of the proper composition for effective results.

Each process requires a lacquer compounded specially for it, considering the lacquer as quick drying, setting etc. Different colors or finishes require special lacquers adapted to them.

(To be continued.)

Lacquer Finishes

By CHARLES WERFT*

In the manufacture of art glass domes, gas and electric portables and electroliers the manufacturer is always on the alert to produce new and pleasing finishes that will appeal to the buying public. Competition is very keen in the electrolier business, the manufacturer that markets new finishes getting the business.

Until recently the buying public demanded such finishes as old brass, brush brass, verde green, oxidized silver and a finish called cloister or statuary bronze. While there will always be a demand for these finishes, the public is now demanding new and unique finishes on electroliers and portables.

The manufacturer, to satisfy this demand and to increase his business, has hit upon the lacquer finishes. Until recently there have been few lacquer finishes upon electroliers and portables. There are three or four lacquer finishes now on the market that are beautiful. This article will deal with a few of these finishes and their method of production.

Mercury Gold Finish

This is a very beautiful finish, and throughout the Eastern part of the country there is a great demand for it. This mercury gold is produced with a yellow enamel lacquer and a fine gold powder. The work is first bright acid dipped and then the high lights are buffed and colored. A glass spray jar is filled three-quarters full of clear lacquer and one-quarter of yellow enamel lacquer is added to the clear lacquer and thoroughly stirred. To this mixture add 2 oz. of fine gold powder (a powder that has a brass appearance will not answer the purpose as well) and stir the powder in the lacquer thoroughly. After stirring the mixture will have a greenish tint. Do not make a stock mixture of this, but mix it when ready to use, as it

deteriorates after standing a few hours.

When the powder has been thoroughly stirred in the lacquer, it is ready to be sprayed on the work. After spraying the parts of the electroliers and portables, the excess lacquer is relieved from the high lights and the work placed in an oven to dry. When the work is dry, use thinner and a rag and remove the rest of the lacquer from the high lights that was not removed before placing in the oven. The article will have a greenish tint, with the gold powder showing through faintly.

The next operation, and one that will bring the gold powder in relief, is the painting of a pigment powder on the article. This pigment powder is made from Paris green and yellow ocher, adding sufficient of the yellow ocher so that after mixing with the Paris green the pigment will have a light green yellowish tint. This pigment is then applied to the work, and then wiped with a rag. The pigment should be dissolved in equal parts of turpentine and boiled linseed oil, to which has been added two teaspoonfuls of hard oil finish varnish. Care must be taken that not too much of the varnish is added, as the pigment will settle too quickly, and it will be hard to remove. After the work has been painted with the pigment and wiped off with a rag, the high lights that were relieved with the thinner are lacquered with clear lacquer by employing a camel's hair brush, after which the article is finished.

Italian Gold Finish

Another lacquer finish that is very pretty and used a great deal on church and theater work is an Italian gold finish, especially when there are plaster of Paris and brass parts to be finished in the same color. This is very acceptable if the manufacturer does not wish to copper plate the plaster of Paris.

The brass is first bright acid dipped to remove the grease and to present a bright background for the next operation. It is then lacquered with a red enamel lacquer and placed in an oven to dry. After drying thoroughly, the same color gold as was used for the mercury gold is used. It can either be painted on the work with a brush filled with turpentine, then clear lacquered, or it can be

*Member A. E. S.

placed in the clear lacquer and sprayed on the work. When the work has been sprayed with the gold powder, replace it in the oven to dry. The work is then painted with burnt umber and the varnish mixture that was used with the mercury gold finish, or the burnt umber can be used with the turpentine alone. After painting, the excess umber is removed with a rag. The umber shows through the gold powder on the high lights.

Old Ivory Finish

Another lacquer finish used on portables extensively is called an old ivory finish. The work is first bright acid dipped, as in the mercury gold and Italian gold finishes, after which it is sprayed with a white enamel lacquer. One coat of the lacquer will not answer the purpose as the work will not have a white color, but will have a blue color. Therefore, the work should receive two coats of the white enamel lacquer. It is then placed in a warm oven to dry thoroughly. It will need an hour to dry sufficiently for the next operation. When dry the work is painted with oxide of iron or burnt umber. The oxide of iron will give the work a slight reddish color, the burnt umber will give it a brown color. In painting the work, care should be taken that too much of the burnt umber is not used, as it will be difficult to remove it. It is removed with gasoline, and is painted on the work with gasoline. The high lights should be a white color and the background should have a slight brown color. By using a little Paris green with the burnt umber, or oxide of iron, a very pleasing greenish brown can be obtained, and with the white high lights it makes a very pleasing contrast. After the work has been relieved with the gasoline it can either be clear lacquered or left as it is. The lacquer makes for a bright finish.

Cobalt versus Nickel Plating

Commenting on the comparative cheapness of cobalt as against nickel for use in plating solutions, we have received and here quote a letter from Mr. W. L. Savell of the metals department of the Deloro Mining & Reduction Co., in Ontario, formerly Research Associate in

the Research Laboratories of Electro-Chemistry and Metallurgy, Queen's University, Canada. The theoretical and practical experience of this gentleman should carry much of value to those who are interested in this subject. He writes:

"In the first place, cobalt anodes may be bought for \$1.50 per pound; in the second place, cobalt plating solutions, when properly operated, have a practically negligible maintenance cost, due to the high anode current efficiencies, in spite of the comparatively high cost of salts, the single salt selling for about 40c. And in the third place, cobalt plates equivalent to a given nickel plate may be produced more cheaply than nickel plates. Extended and conclusive tests show that from one-fourth to one-third the usual nickel deposit is sufficient in the case of cobalt plating to furnish the same protection from corrosion and a superior protection from wear, due to the great density and hardness of the cobalt plates as compared with nickel plates. Also the installation of cobalt plating equipment, including the plating solutions and anodes, will be considerably less than that of a nickel plating equipment designed to handle the same amount of work, since the speed of plating with cobalt is from five to ten times greater than the greatest nickel plating speeds, and only one-fourth to one-third the deposit is required, so that an equivalent plate may be deposited in one-twentieth to one-sixtieth of the time used for nickel plating. In other words, satisfactory deposits equal in every way to a one-hour nickel deposit may be obtained with cobalt in one minute if desired. These figures have been verified in both laboratories and plants. I would refer you to the recent publication by the Canadian Government 'Electroplating with Cobalt,' Bulletin No. 334. Also I can refer you to engineers of one of the largest manufacturing corporations in the United States to confirm the above, with results of their own tests if you wish."

When windows in a foundry are not cleaned for a long period the glass often becomes rust-pitted, almost entirely opaque, and therefore useless for the admission of light.

Albany Molding Sand

By D. H. NEWLAND*

The following paper, the writer wishes to preface, is distinctly preliminary in nature, based on work that is still in progress. In brief, it aims to describe some of the more important features of the molding sands, about 500,000 tons of which are annually supplied to Eastern foundries; this sand is generally recognized as standard for certain classes of work. Particular emphasis will be placed upon the characteristics of the sands in the field, which affect their production, future supply, marketing and use. Little will be said in regard to physical properties as interpreted by laboratory tests, a branch of the subject which the writer must confess his inability to present adequately at this time. In fact there seems to be a great deal of confusion, or at least lack of agreement, as to the best methods for measuring the physical qualities of molding sand, as defined by texture, bond, permeability, refractoriness, etc., and it can hardly be said that any really scientific scheme for testing has yet been evolved. Herein lies an opportunity for an important service to technology. For whether or not laboratory methods can be devised that will serve as a substitute for the tests of practical experience in the foundry, no doubt exists that there is need of some means of comparing and classifying sands in the field which will take the place of present loose practice.

The name Albany sand, as recognized in the trade, applies to the molding sands that are found in the middle Hudson Valley in the stretch from Glens Falls on the north to the vicinity of Kingston on the south. The productive district consists of a narrow belt that reaches only a few miles back from the shore line on either side of the river. In the vicinity of Albany and immediately north of that city the belt is considerably wider than the average, extending as far west as Schenectady and Ballston, twelve miles or so from the river. It is in this wider section that most of the sand is now produced. The largest quantities are shipped from Albany, Schenectady and Rensselaer counties, while smaller amounts are

produced in Ulster, Columbia, Greene, Saratoga and Washington counties.

Geological Features

The distribution of the sand, as indicated above, accords with certain geological features which may be briefly set forth. The district is practically co-terminous with the site of a former lake which in the late glacial period occupied the Hudson Valley. This lake was formed, it is thought probable, by a temporary obstruction in the lower part of the valley which served to hold back the waters of the Mohawk and upper Hudson until they reached the height of something over 300 ft. above sea level, as defined by the marks of the old shore lines. In these quiet waters great quantities of sediment, principally clay and sand, were deposited, having been brought down by the Mohawk, upper Hudson and other streams that drained into the lake. The deposits lie on either side of the river in regularly bedded succession and show steep banks fronting the river; their upper surfaces are defined as a series of terraces, familiar to anyone who has visited this section, since practically all of the cities and villages are built on their sides and summits.

The sand deposits of this glacial lake (Lake Albany) are mainly in the uppermost part of the sedimentary accumulation. They form a mantle over most of the area, being underlaid by the clays which are the basis of an enormous brick-making industry, the Hudson Valley being the largest center of common brick manufacture in the country. The surface sands are mainly of fine texture, and here and there have been heaped up by wind action into ridges or dunes to a thickness of 100 ft. or more, but generally they are rather thin, seldom averaging over 15 or 20 ft. In some parts of the district these sands are still being moved around by the winds as living dunes, but for the most part they are now anchored by vegetation and covered by soil.

That the wind has been an important agency in sorting the sands seems quite certain, and to its effect may be ascribed in great part the remarkable evenness of grain which the typical molding sands exhibit.

*Presented at meeting American Foundrymen's Association, Atlantic City, N. J.

The molding sand proper, the sand suitable for use in foundry work, is found only here and there over a small fraction of the total area. Its distribution is quite irregular. It always lies directly below the soil, and the typical material seems never present except where so covered. It varies from a few inches to 4 or 5 ft. thick, the average being from 2 to 3 ft. Where a greater thickness is excavated than the maximum mentioned, it is usually done by extending the cut down into the underlying *open* sand which is then mixed with the true molding sand.

This open sand is a grayish sand which resembles the molding sand in texture, but contains some shale and sandstone in place of the quartz and, on the other hand, has not so much clay bond. It underlies the molding sand layer, resting in turn upon the clay.

General Character

The molding sands from the Hudson Valley are mixtures of quartz sand and clay in the proportion roundly of about 3 or 4 to 1. They are remarkable for their very fine texture which is the property which makes them especially valuable in metallurgy. In color they are brownish yellow, owing to the presence of a little limonite which adheres to the quartz grains. The clay is very evenly distributed and forms an outer coating to the particles.

The fineness of grain is the most important feature that distinguishes the sands of this section from most deposits elsewhere. It seems to be the result of a combination of factors. The sand was ground and comminuted under pressure supplied by the moving ice-sheet; following this it was sorted by water and laid down in the quiet waters of the lake; and finally with the disappearance of the lake water the sand deposit was blown about for a period of time by the winds which effected a thorough sorting according to size. Of the typical brass and stove-plate sands, screen tests show that often 95 per cent or more of the entire material will pass through a 100-mesh screen. As an example, a stove-plate sand from Selkirk, Albany County, gave the following results: Through 100 mesh,

96.64 per cent; on 100 mesh, 2.62 per cent; on 80 mesh, 0.39 per cent; on 60 mesh, 0.04 per cent; on 40 mesh, 0.07 per cent; on 20 mesh, 0.21 per cent. The average grain diameter of a sand produced within the limits of Albany City is 0.06 millimeters.

The sand is gathered for shipment wholly by hand labor. The deposit is worked in strips about 3 ft. wide, from which the sod first has been removed. The cutting of the sod and excavation of the sand is performed with an ordinary shovel. By carefully placing the sod and attached soil right side up in the adjoining strip of excavated ground the land can be returned to agricultural uses without much damage. The sand is hauled by wagons to the nearest point of shipment, where it is usually placed in a stock pile, the different grades of course being kept separate. In this way it is possible to secure a more uniform material than if the sand is taken from the field directly to the car. Simple and crude as the methods of production are, they probably are as economical as any that can be devised under the conditions, for constant attention is required in the operations to secure the desired quality of material. The principal need for improvement seems to lie in the methods of grading which are unsystematic and differ with each particular producer.

The owner of the land that is under exploitation receives a royalty figured on the basis of yield or a round sum for the entire product. The amount paid, of course, varies greatly according to conditions—the thickness and quality of the layer and the distance to the nearest railroad siding. As a rule the sand is not hauled over five miles.

It is difficult to make any estimate of the acreage of sand that is available for future supply. There is undoubtedly a large area in the aggregate that is still unworked, sufficient to maintain the present rate of shipments for many years to come. The present production exhausts about 125 acres a year, on the basis of a deposit averaging 2 ft. thick, which is not a very rapid rate when the size of the district is considered. As stated previously, however, the valuable sand covers a very small part of the total area, probably not more than 1 per cent, if as much.

What's the Matter with the Foundries?

By J. P. BROPHY*

Undoubtedly, thousands of people who have more or less to do with foundries will claim that there is nothing the matter with them, but from experience—and some of it really costly—I must say that there is much the matter with many of the foundries in this country at this time, and there has been right along. I maintain that as far as the quality of castings is concerned the foundries are not one particle better than they were twenty or more years ago. There is just as much uncertainty now as to what you might expect from your patterns from so-called first-class foundries as there was a quarter of a century ago. This positive statement is based on bitter experience.

Poor castings are detrimental in two ways. The one who receives them perhaps discovers in the last operation that there is a blow-hole or a dirty spot in some section, and the consequence is that he generally loses the labor expended. In many instances it sets back the producing power of his plant, because a number of inferior castings coming in quantities, of which you perhaps have none in stock, means that all the operations of setting up and machining are wasted. Nevertheless, they are slow to grasp or slow to be able to improve to the extent of being able to anywhere nearly guarantee that if you order fifty castings from one pound to one thousand pounds they will be practically all the same and usable.

The producing of small castings by the use of machinery and otherwise has perhaps reached the maximum in the foundry, but when it comes to quality, uncertainty prevails in all directions. If it is because of inferior sand being used or inferior ramming of the mold, or inferior venting or anything inferior in the labor in preparing the flask for the metal to be poured, why is it that with all the experience the foundrymen have had for a generation they have not been able to discover where the trouble lies and are not able to say for a certainty what the results are going to be?

When returning inferior castings to

the foundries, either before or after work has been performed on them, they take it as a matter of course and seem to expect a considerable portion of their castings to be returned. If you send in a complaint, there is a possibility that the foundry foreman will visit you and talk matters over, but from past experience you feel almost certain that all this talk is a waste of time, for the reason that they do not seem to be able to improve in producing their product.

If a pattern is sent to a foundry to-day (and it makes no difference what foundry it might be) which is cored considerably, you can feel quite certain that the cores will either be set in the wrong position or something will happen to this casting—perhaps two or three times—before you finally obtain the results that can be obtained after a great many have been made.

Many large foundries would be ahead thousands of dollars a year in net earnings if the castings they produced came anywhere near a fair percentage in soundness.

Is it possible that the foundries are careless in mixing their iron before placing it in their cupola? Is it not possible that the iron is not brought to the proper temperature before being poured? Is it not possible that the gates where the metal travels to its destination are in the wrong position—too small or too large—is there something wrong with this part of the foundry business?

Many foundries are exceptionally negligent in their mixture of iron—there is no question about this. Many times you pay for what you don't get. Cast iron should be of a standard tensile strength, at least in the machine tool business, and when 20 per cent steel is used there should be a standard for this also. The writer has known of cases where 20 per cent steel was asked for, and in analyzing no steel could be discovered at all, but an inferior grade of ordinary cast iron. This shows that some foundries are exceptionally careless, or else willfully accept money that doesn't belong to them. To be anywhere nearly sure of what you are receiving, it seems necessary to analyze each lot of castings to determine their quality.

Up to this point this talk has been on

*Cleveland Automatic Machine Co. Extracts of articles in *Machinery*.

ordinary gray iron. The same might be said of steel castings. No dependence can be placed on steel castings. You never know what you are getting. There is no question but that the steel casting business is just as far behind as it was twenty years ago.

Consider malleable iron also. We do not seem to have any improvement on this line of goods. It seems to be made in the same old way. There is no telling, for a certainty, what you are going to receive. If tested for tensile strength you will discover that it varies in all directions.

Another source of considerable trouble is the fact that you cannot depend upon the foundries to produce castings of the same thickness as your patterns. This is either carelessness in rapping the pattern before removing it from the mold, or in giving you over-weight castings. Many times when a casting should actually weigh 1000 lb. it will come 1200 or 1300 lb. This is inexcusable, but it seems almost impossible to defend yourself against it.

Regardless of the kind of castings being made, large or small, the metal in many cases is poured from one cupola, and you take what you get and let it go at that. In the writer's estimation it seems that any good foundry should have a number of cupolas with various mixtures to suit the requirements of the various castings they are producing.

New Form of Safety Goggle

The latest development in safety goggles was the feature of the report of M. W. Alexander, chairman of the National Founders' Association's committee on safety and sanitation. In investigating the goggle question, the committee's safety assistant visited numbers of shops over a period of several weeks and discussed the question with the workmen themselves. It was found that when the average man is left to himself he resorts to the 10- or 25-cent store and obtains a goggle with a leather or rubber support for the glasses, which support adjusts itself to the contour of the face and is held in place by a strap or an elastic passing around the head.

The result of the investigation was

that the committee set to work to develop a kind of goggle which would have a combination of leather and metal side guard to cover the face without a nose piece and having the flexible elastic to fit around the head instead of the temple bows fitting over the ears. Samples of these were sent to thirty-six members of the association and all but one reported that they were the best goggles that have yet been designed. They were then put in the finished form, which Mr. Alexander exhibited. In this the eye cup is extended from the leather base by means of a perforated metal support for the lens, with the result that the lenses are far enough from the face not to be brought into contact with bushy eyebrows and afford openings through the use of the perforated metal all around instead of only at the sides, so that there is ventilation and the goggles are not subject to fogging. The leather is treated with oil so that it is not attacked by sweat and is non-hardening even after use in a sterilizing solution. The lenses are readily removed in case of breakage or to allow for corrective lenses to accommodate the eyesight of the user or to admit colored lenses as for use in oxy-acetylene work or for furnace tenders.

The goggle has been approved by the Conference Board on Safety and Sanitation, and a contract has been entered on for the delivery of 1000 dozens, and it is understood that the effort will be not to have the goggles cost more than 75 cents a pair. It may be added that the lens is held in place by an eye ring which has a latch so that the glass may be easily removed, and there are no small screws to be lost.

Copper-zinc alloys crystallize nearly all in octahedrons of the monometric system, and in the hollow spaces of castings octahedral formations of considerable size are not infrequently found, the composition of which by no means always shows a chemical combination composed according to atomic proportions.

Gold-silver, lead-silver and silver-mercury alloys crystallize in the monometric system.

FROM AMBER TO DYNAMO

PART XIII—Commutation

By H. E. Willmore, Jr., B.S.

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Commutation is the greatest source of trouble in the operation of a dynamo or motor.

Since the commutator itself is an important part of the machine and very difficult and expensive to replace if injured, it is quite important that the plater should have a good working knowledge of the theory of commutation, the disturbances which are likely to occur, and the remedies therefor, in order that he may give this part of the machine the care which it requires.

As has already been explained in Part XI, when the armature of a dynamo is revolving in a magnetic field, the current induced in the windings is constantly surging back and forth, or alternating, and the function of the commutator is to take this alternating current at the moment at which it is about to change its direction, and to "re-reverse" it, so that the ultimate effect will be the production of a current whose flow is always in the same direction. In Part XII it was shown that this commutator consists of a number of solid copper bars, one for each coil in the armature winding, and each bar insulated from the others, put together in the form of a hollow cylinder with brushes bearing on its surface to carry away the power produced.

Theory of Commutation

For a better understanding of this subject assume a simple case, illustrated in Fig. 36. Although for the sake of simplicity it is not shown that way, assume that coils 1, 2 and 3 are full pitch windings, assume also that the brush shown is located at the neutral point in the magnetic field, that this neutral point remains fixed, that while passing through the neutral position the windings cut no flux, and that with the direction of rotation of the armature being to the left, the current circulates in the windings

as shown. In Fig. 36-A the coil marked 2 is approaching the neutral position and therefore is about to be commutated. The brush is in contact with only one bar, *b*, and while coil 2, being in the neutral position, is not cutting flux, there is a current flowing through it from coil 3, because that is the only way in which the current from 3 can get to the brush. As the commutator moves to the left and the brush comes in contact with bar *c*, part of the current from 3 flows

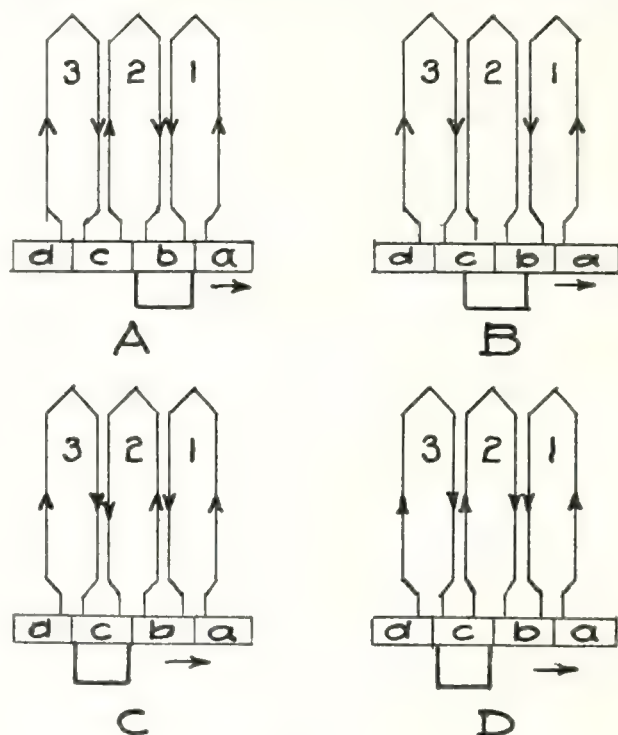


Fig. 36

directly through bar *c* to the brush. But before position *B* is reached, the resistance between bar *b* and the brush is less than the resistance between bar *c* and the brush; consequently some of the current from coil 3 still goes through coil 2 in the same direction as before. When position *B* is reached, however, the resistances from bars *b* and *c* to the brush are the same, and any pressure from 3 that tends to force current through 2 will meet an exactly equal and opposite pressure from 1, hence the result is that the

full currents from both 1 and 3 pass through their respective commutator bars to the brush and there is no current flowing through 2. After the commutator passes this position, the resistance from bar *b* to the brush becomes greater than from bar *c* to the brush and part of the current from 1 flows through coil 2, and finally as position *C* is reached the full current from 1 is flowing through coil 2, but in the *opposite* direction from which the current was flowing in position *A*, and commutation of this coil is thus completed, for we have reversed the direction of the current in the coil without having changed the direction of the current flowing through the brush.

Sparking

This process would be quite successful if the current in coil 2 would reverse at the proper time, according to our theory outlined above, but it is found that there is something else here which has been neglected. In Part XI a consideration was had of self-induction, the electromotive force which is generated in an electromagnet when the circuit is broken. Self-induction acts very much like the inertia of moving bodies, and just the same as it takes time to stop and reverse a heavy body which is in motion, due to its inertia, so it takes time to stop and reverse the current which is flowing in a circuit having self-inductance; and when you do attempt to stop this flow of current by breaking the circuit, the electromotive force due to self-induction tends to prolong the flow and thus causes current to jump across the gap just made, producing a heavy spark between the two contact points. A commutator revolves at a pretty high speed and this makes the time of commutation very short, so short in fact that while the commutator has traveled from position *A* to position *C* in Fig. 36, the self-induction of coil 2 manages to keep the current still in motion, so that when position *C* is reached, the current in this coil has not only not been reversed as it should have been, but it is actually still flowing in the same direction as in position *A*; so that as bar *b* breaks contact with the brush, current from bar *b* still continues to flow to the brush across the gap and we have a good

sized spark formed. Having once broken down the dielectric strength of the air gap between *b* and the brush, there is a rush of current through this path from coil 2 and coil 1 and all the coils between coil 1 and the brush beyond it, and we thus have an arc similar to the arc produced between two carbons, smaller in magnitude, to be sure, but still able to generate locally an extremely high temperature in the metal which is in contact with it. The result of this high temperature is, of course, that a small amount of the copper will be volatilized each time, and before long the commutator and brushes are so roughened, or "scored," as to require repair or replacement.

Factors Influencing Sparking

In order to be able to remedy the above difficulty we must first have a thorough knowledge of the various factors which serve to increase or to modify the effect of self-induction. The following agencies are of considerable importance:

1. The time of commutation.
2. The intensity of the current being commutated.
3. The self-inductance of the coil to be commutated.
4. Contact resistance between the brush and the commutator bars.
5. The resistance of the coil itself.
6. The direction and intensity of the flux being cut by the coil.

It has already been shown that sparking occurs because the time of commutation is not long enough to allow the current to be reversed in the coil being commutated, so that there is a possibility of improving commutation by lengthening the time of commutation. There are three ways in which we might do this: We might slow up the speed of rotation of the machine; we might make the commutator in fewer sections, so that each section will be larger, or we might widen the brushes. With any of these changes, however, we run into further difficulties.

In the first place it would be impracticable to greatly reduce the speed of rotation of the armature, because the amount of power transmitted by a shaft is proportional directly as the speed of rotation and as the torque, or turning

effort; so that if we decrease the speed, we must increase the torque to transmit the same power, and this would mean the use of shafts of prohibitive size. Again, suppose that we were to decrease the number of commutator segments in order that each segment could thereby be made larger, and thus would remain in contact longer with the brush. Decreasing the number of commutator segments means a decrease in the number of coils in the armature, and since each coil must carry its share of the current, with a fewer number of coils, each one must carry a correspondingly heavier current and, as shall be shown presently, the heavier the current being commutated, the greater the effect of self-inductance and the worse the sparking. Increasing the size of the brushes to cover more than one bar would also serve to increase the amount of current being commutated.

The self-induction of a circuit is equal to $L i^2 \div 2$, where L is a coefficient which is constant for any circuit and i represents the change in current. Since the self-induction increases directly as the square of the current, it would be of benefit to reduce the amount of current flowing through each coil, which may be accomplished by simply increasing the number of paths in parallel between brushes, or in other words, by increasing the number of multiple coils in the armature. Thus in a machine with six poles and multiple-drum winding (see Part XII) there are six paths in parallel between brushes, therefore each winding carries only one-sixth of the total current. Thus, increasing the number of poles decreases the amount of current being commutated and improves commutation.

The coefficient of self-induction, L , mentioned above, is a factor which depends upon the kind of a circuit we have. It increases with the number of turns in the coil, and is further increased because the armature coils are partially surrounded by iron.

In a full pitch winding, Fig. 37-A (see also Part XII), the two conductors in the same slot are both being commutated at the same time, which means that the flux set up by each conductor will link with the other one, and thus there is an interaction which serves to

increase the self-induction. In a fractional-pitch winding (see Part XII), the two conductors in the same slot are not commutated at the same time, therefore fractional-pitch windings have an advantage over full pitch windings in this respect, inasmuch as the coils which are being commutated at the same time are far enough apart so that there is little interlinking of the flux from one coil with the conductors of the other coil.

Resistance Commutation

Referring to Fig. 37-B, contact r_1 must

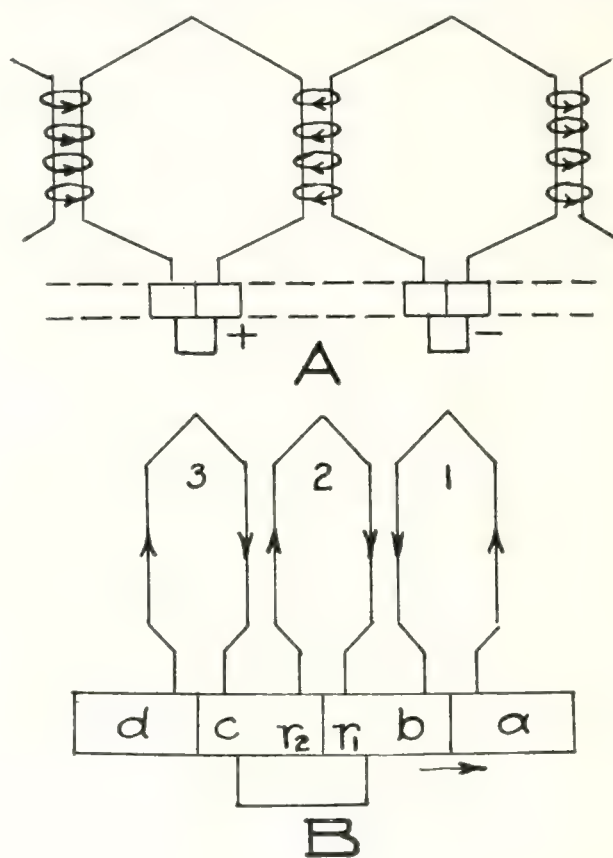


Fig. 37

carry current in parallel from coils 1 and 2, while contact r_2 carries much less current than contact r_1 . Consequently, even with the areas of the two contacts the same, the voltage drop across r_1 is greater than across r_2 and there is a slowing up of the current in coil 2. Also, as the commutator continues to move, resistance r_1 continues to become greater than r_2 at a rapid rate, and there is a still greater voltage drop across r_1 . If the brush were made of some comparatively high resistant material, such as carbon or graphite, by the time the position shown in Fig. 37-B were reached, r_1 would be so great that the current from bar b could not cross it, and it would be forced to follow the path of least resist-

ance around through coil 2 and bar *C*, thus forcing a reversal of the current in the coil 2. In practice where it is possible, the brushes are usually made of carbon or graphite for this reason. They have the further advantage of less mechanical wear on the commutator. In plating generators, the currents generated are so large that these carbon brushes will not carry them, and copper brushes must be used. The plater, however, will meet with carbon brushes, if he uses a motor for driving power. This type of commutation is known as "natural" or "resistance" commutation, and is seldom used alone, but usually in connection with another type, to be taken up presently.

The resistance of the coil will oppose the reversal of the current through the commutated coil, in the same way that friction opposes the motion of a heavy body. Its effect, however, is small.

Voltage Commutation

Thus far in the discussion the brushes have been kept on what are known as the neutral points, the points at which the armature conductors are not cutting flux. At a certain distance to the right of the brush in Fig. 37-B it will be seen that the current in coil 1 is flowing in the opposite direction to the current in coil 3. This is because coil 1, being on the side of the neutral point opposite to coil 3, is cutting magnetic flux in a different direction from which coil 3 is cutting it. If now, instead of setting the brushes on the neutral points, we gradually move them ahead in the direction of rotation of the commutator, we shall bring them into a region where the armature coils are cutting flux in the opposite direction from before, and thus there is a counter pressure induced which opposes the pressure of the current already flowing and tends to reverse it.

As we proceed, we finally reach a region where this reverse electromotive force induced is strong enough to more than neutralize the self-induction of the coil, so that by the time the coil is being commutated, the current in this coil is already flowing in the proper direction, and we have thus reached a condition in which there is no tendency to spark. For this reason the brushes on generators are

carried on a frame that can be shifted. By carefully adjusting the brushes it is possible to obtain a position where there will be little or no sparking, and if the load does not change too much, this condition will remain. This method of reducing sparking is known as "forced," or "voltage" commutation and is usually used in connection with "resistance" commutation, giving a combination which reduces sparking to practically nothing, so long as there are not wide variations of load on the machine.

Armature Reactions

Only one difficulty is encountered in the above system. The success of voltage commutation depends upon the brushes being the right distance ahead of the neutral points. If the relative positions of neutral points and brushes change very much for any reason, the adjustment is spoiled. So far, we have thought of the magnetic flux between the poles of a dynamo as being set up and affected only by the field windings, and when no current is being taken from the machine, this is quite true. It must be remembered, however, that as soon as we start

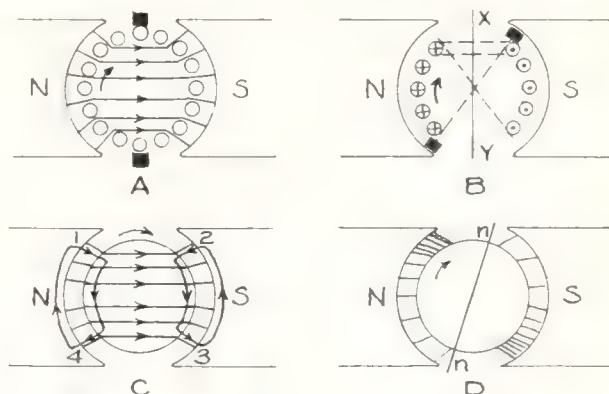


Fig. 38

to take power from the machine, current flows through the armature and this sets up a magnetic flux which is bound to have some magnetic effects on the flux from the field windings. This magnetizing action from the armature windings is known as "armature reactions" and may be divided into two parts: First, the cross-magnetizing action which distorts the field; and second, the "demagnetizing" action which opposes the field. Referring to Fig. 38, suppose we take, for simplicity's sake, a two pole machine. Conductors in the armature winding will be represented by small circles; where the current is flowing away from us a

cross will be placed in the circle, and where it is flowing toward us a dot will be placed; 38-A represents the generator at no load, where there is no current flowing through the armature and the magnetic flux from north to south pole is not appreciably distorted or diminished. In *B*, current is being taken from the machine, and we have moved the brushes ahead to prevent sparking. The conductors included between the two dotted lines which run through the axis of the armature in this figure are known as the “cross-magnetizing” turns of the armature. We may think of each conductor being paired with a conductor on the side opposite, so that the pair taken together forms a complete turn, as shown by the horizontal dotted lines. Taking all these pairs of conductors together, they form a helix whose axis runs vertically through the center of the armature as line *xy*, and applying the Right Hand Rule it is evident that the magnetic flux from this helix is flowing upward on the outside and downward on the inside of the helix as shown in 38-C.

From the directions in which the lines from the helix are flowing one can easily see that they will tend to oppose the other field at points 2 and 4, Fig. 38-C, and will tend to strengthen this field at points 1 and 3, the result being a distorted field, as shown in *D*, where the tips of the poles toward which the armature is turning are weakened and the tips from which it is turning are strengthened. The final result of this distortion is that the neutral points of the field are moved ahead; instead of being located on a vertical line through the center of the armature, they are now located on a line which has been revolved ahead, such as line *n-n* in *D*. It is easy to see that the degree of cross-magnetizing action depends upon the amount of current that is flowing through the armature, which in turn increases directly as the total output of the machine. Therefore when we change the load on the machine, we invariably shift the neutral points and hence a setting of the brushes which gives sparkless commutation at one load will theoretically not give sparkless commutation at some other load, so that whenever the load changes greatly, for any reason, it

will be necessary to shift the brushes until another position has been found at which sparking does not occur.

In practice, however, conditions are not quite so bad as this, for it is found that if the brushes are so set as to give good commutation at the average load, then the contact resistance of the brushes will take care of most ordinary fluctuations from this load, and in fact it is found that with modern types of dynamos, if the brushes are once correctly set, they will give good commutation over a very wide range of load changes.

Fig. 39-A represents the “demagnetizing” turns of the armature. As before, these conductors may be thought of as forming a helix, but this time with the

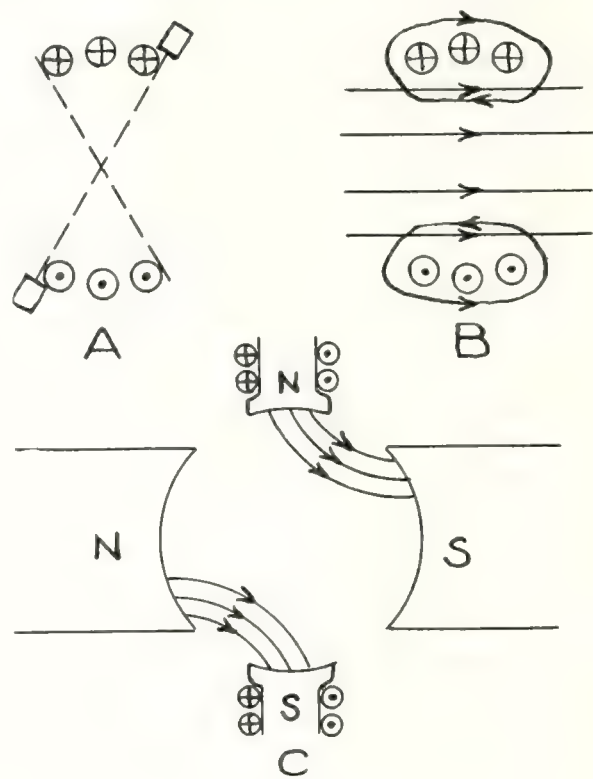


Fig. 39

axis horizontal. Here the flux from this helix flows toward the left on the inside of the helix and toward the right on the outside. *B* shows how this flux opposes the flux from the field windings and thus has a “demagnetizing” action on the flux cut by the armature windings, which therefore tends to reduce the voltage of the machine. From all that has so far been considered, it is evident that as we increase the load on the machine, we must shift the brushes ahead to reduce sparking; but as we do this, we also increase the number of demagnetizing

turns and at the same time, with the increased load, there is greater current flowing through each of these turns. Thus, increasing the load gives a double-effect decrease of the flux, with a corresponding drop in voltage for this higher load.

The Interpole Dynamo

Fig. 39-C illustrates a device which has been designed to offset both the cross-magnetizing and demagnetizing effects of the armature reactions. Mid-way between the main poles of the generator, small auxiliary poles are placed, an auxiliary north pole always near the "trailing" tip of the north pole, and an auxiliary south pole always near the trailing tip of the south pole, as shown in the figure. The function of these auxiliary poles or "interpoles," as they are called, is twofold: Referring to the figure it will be noted that the extra flux from these poles is in the same direction as the flux from the main poles, so that its effect is to counterbalance the demagnetizing action of the armature reaction; also you will see by comparing this figure with Fig. 38-D that the place where this extra flux enters the main poles is at the same tip of the pole that has been weakened by the cross-magnetizing armature reaction, therefore the interpole also counterbalances this cross-magnetization.

Further, the winding in these interpoles is connected in series with the armature windings, so that their magnetic effect increases with the current output of the machine; therefore as the armature reactions increase, the counterbalancing action of the interpoles also increases in the same proportion. The ultimate results are obvious: There is no voltage drop with increasing load due to armature reactions, the neutral points are not shifted with a change in load so that there is no sparking, and besides this, the series winding of the interpole with the shunt winding of the main poles gives us a compound field winding. With an interpole generator, therefore, we get practically constant voltage at any load without changing any field rheostats, and we get sparkless commutation at any load without changing any brushes. The introduction of the inter-

pole marked a great improvement in generators and also in motors.

So far its use in plating dynamos has not become general, but there is at least one electroplating supply house manufacturing a plating dynamo with this feature.

Attaching Spring Handle to Split Stripper Ring

By W. E. DUGGAN

The sketch shows a simple and inexpensive way to attach the spring handle to the split stripper ring used in stripping the tube from the push bar after the brass tube has been pushed through the reducing die in the draw bench.

Each half ring has the U-shaped locking slips cast on them as shown in Fig. 2.

The handle is made of $\frac{3}{8}$ -in. steel formed as shown in Fig. 1.

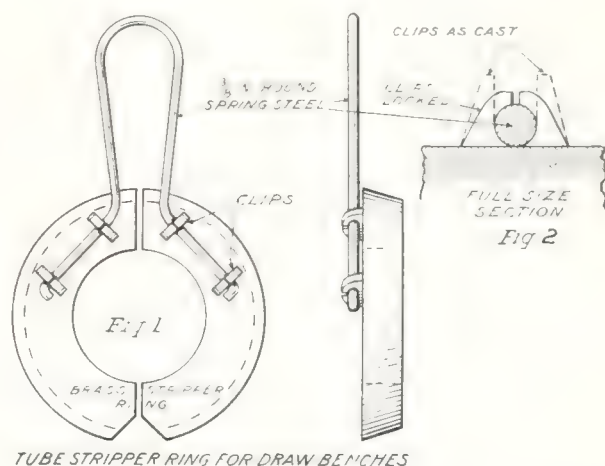


Fig. 2 shows the clips bent over the handle, thus locking it securely in place.

The only labor required with this method of attaching the handle to the rings is the bending of the U clips over the handle.

The handle is easily removed from the worn ring, and can be put on a new ring.

The use of hoods for brass melting furnaces, for core ovens and for ventilated foundry stoves is taken up at some length in the safety bulletin, issued by the National Founders' Association, M. W. Alexander, West Lynn, Mass., chairman of the committee on safety and sanitation. The bulletin also illustrates discharge spouts for sand and small casting work, and offers a sketch of a wire screen shelf for bench molders.

Fatigue of Copper Alloys

By ERNST JONSON*

Experience has shown that copper alloys are subject to cracking under certain conditions of stress and exposure. In order to determine the magnitude of the stress at which cracking is liable to occur, a series of long-time tension tests has been started, in which the test specimens are exposed to the action of ammonia while under stress. In order to discover which alloys are subject to cracking, all the common alloys will be included in this series of tests.

Results have been obtained from the following alloys: Manganese bronze, naval brass, Muntz metal and gun metal. All the specimens of these metals cracked when the stress reached a value between 20,000 and 27,000 lb. per square inch. Specimens of manganese bronze exposed to high stresses for a long time, but protected from corrosion, did not crack. Other specimens of manganese bronze, which were corroded without being under stress, were not injured thereby.

The following conclusions have been drawn from the tests:

Excessive stress alone does not injure copper alloys, nor does corrosion alone, or corrosion accompanied by moderate stress. Corrosion, accompanied by prolonged stress exceeding 20,000 lb. per square inch is liable to cause cracking in any of the above-mentioned alloys. We must therefore regard 20,000 lb. per square inch as the practical ultimate strength of copper alloys, and the working stress must be taken as a safe fraction of this ultimate strength.

In previous papers the writer has pointed out that the occurrence of so-called season cracking in brass rods is conditioned by (1) high initial tensile stress in the surface of the rod, and (2) by corrosion of the metal; also, that a brass rod may develop cracks of the same nature as season cracks when stressed beyond the initial yield point by an external load, instead of having initial stress set up by the cold drawing of the rod, and that such cracking is not peculiar to one kind of brass but that

all kinds of forgeable brass are subject to it.

At the time of the previous writing, the following brasses were tested and cracked when etched with ammonia, while under stress greater than the initial yield point: Cast manganese bronze from two foundries, plain-extruded manganese bronze, rolled and drawn manganese bronze, plain-extruded naval brass, drawn naval brass, and plain-extruded Muntz metal. No cracking has been observed where high stress and corrosion did not co-exist. From these facts the conclusion was drawn that the ordinary ultimate strength of brass is developed only when the metal is broken so quickly that cracks do not have time to develop, and that when a stress exceeding the yield point is applied for a considerable time the metal will fail by cracking.

The working hypothesis formed for the purpose of co-ordinating these facts and to guide further investigations is as follows:

In copper alloys there are microscopic flaws. When the tensile stress approaches the yield point these flaws are opened sufficiently to admit corrosion. This corrosion weakens the edges of the flaws and causes them to increase under the continued action of the stress, and thus a continuous crack is formed which gradually increases in depth. When the crack has so reduced the cross-section that the stress on the remaining solid portion exceeds the ultimate strength, the rod breaks.

In order to more definitely determine the magnitude of the stress at which cracking begins another series of tests has been started. Each test was made as follows: A tension test specimen of 1-in. diameter and 8-in. length, with a reduced diameter of 0.8 in. and 6-in. gage length, was placed in the testing machine. A sheet steel cup with a 1-in. hole in its bottom was put on top of the lower grip so that the end of the test specimen passed through it, and the cup was filled with strong ammonia. Some absorbent cotton was tied to the test specimen so as to keep it wet by capillarity, and the cup and test specimen were covered by a conical paper hood so as to confine the ammonia fumes. A stress

*Paper presented before the 18th annual meeting of the American Society for Testing Materials. Summary by The Chemical Engineer.

of 10,000 to 17,000 lb. per square inch, increased in increments of about 3000 lb. per square inch at intervals of a day or more, was applied to the test specimen. Under the higher stresses the test specimen continued to stretch for a considerable length of time, and in such cases this time was added to the interval between the additions of load.

The test specimen was examined before each increment of load was applied. When the first crack was seen the test was concluded, because experience has shown that a crack once started will increase in extent until the test specimen fails, even if the load is not increased. The cracks were similar to season cracks; the largest was generally found where the test specimen emerged from the liquid. In some cases this crack was the only one present; in others there were quite a number of cracks distributed over the length of the test specimen.

TABLE I.—RESULTS OF TESTS
No. 1—Manganese Bronze, Plain Extruded

Time of test.	Load, lb.	Stress, lb. per sq. in.
Nov. 23, 1914, 10:40 a. m., to 25, 10:40 a. m.	5,000	10,000
Nov. 25, 10:40 a. m., to 27, 10:40 a. m.	6,500	13,000
Nov. 28, 11:30 a. m., to 30, 10:15 a. m.	10,000	20,000
Nov. 28, 12 noon, beam had dropped 0.5 in. and was raised.		
Nov. 30, 5 p. m., to Dec. 3, 10 a. m.	11,500	23,000
Beam had to be raised every half hour until Dec. 5, 11:30 a. m.		
Dec. 5, 10 a. m., to 7, 10 a. m.	11,500	23,000
Dec. 7, 1 p. m. to 1:30 p. m.	13,500	27,000
Beam dropped and was raised continually until specimen broke by cracking. There were numerous cracks in immersed portion of test specimen. The last increment of load was evidently too great. A smaller increment probably would have started cracking.		
No. 2.—Manganese Bronze, Plain Extruded, Heated to Near Melting Point, Quenched in Water		
Dec. 18, 9 a. m., to 19, 9 a. m.	7,000	14,000
Dec. 19, 9 a. m., to 20, 9 a. m.	8,500	17,000
Dec. 20, 9 a. m., to 21, 9 a. m.	10,000	20,000
Dec. 21, 9 a. m., to 24, 5 p. m.	11,500	23,000
Beam raised continually.		
Dec. 24, 5 p. m. The specimen failed by cracking; two large cracks on opposite sides of specimen, each crack extending over half circumference; two minor cracks; all in immersed portion. See Fig. 1 (a).		
No. 3—Manganese Bronze, Plain Extruded		
Dec. 24, 9 a. m., to 28, 9 a. m.	8,500	17,000
Dec. 28, 9 a. m., to 29, 9 a. m.	10,000	20,000
Dec. 29, 9 a. m., to 30, 12 m.	11,500	23,000
Dec. 30. Beam dropped and was raised continually. Specimen failed by cracking; one large and several small cracks in immersed portion.		
No. 4—Naval Brass, Plain Extruded		
Mar. 25, 1915, 3:30 p. m., to 26, 3:30 p. m.	5,000	10,000
Mar. 26, 3:30 p. m., to 29, 12 m.	6,500	13,000
Beam raised Mar. 27, 9 a. m., and 28, 9 a. m.		
Mar. 29, 12 m., to Apr. 1, 1 p. m.	8,500	17,000
Beam raised Mar. 29, 1 p. m., 3:30 p. m.; Mar. 30, 9 a. m., 1 p. m.; Mar. 31, 9 a. m., 1 p. m. Specimen removed from machine Apr. 1, 1 p. m. to 3 p. m.		
Apr. 1, 3 p. m., to 2, 12 m.	10,000	20,000
Beam raised Apr. 1, 5 p. m.; 2, 9 a. m. and 10 a. m.		
Specimen failed by cracking, at 12 m., Apr. 2. Three large cracks, and some minor ones in immersed portion. See Fig. 1 (b).		

No. 5—Muntz Metal, Plain Extruded		
Mar. 8, 1 p. m., to 9, 3 p. m.	5,000	10,000
Mar. 9, 3 p. m., to 10, 3 p. m.	6,500	13,000
Mar. 10, 3 p. m., to 15, 5 p. m.	8,500	17,000
Beam raised Mar. 10, 5 p. m.; 11, 9 a. m., 11 a. m., 1 p. m., 5 p. m.; 12, 5 p. m.; 13, 5 p. m.		
Mar. 15, 5 p. m., to 24, 5 p. m.	10,000	20,000
Beam had to be raised continually from Mar. 16, 9 a. m., to 22, 3 p. m.		
Mar. 24, 5 p. m., to 25, 3 p. m.	11,500	23,000
Beam raised continually until 3 p. m. on Mar. 25, when specimen failed by cracking. One crack appeared near the upper thread and one near the lower thread. Several other cracks appeared on the immersed portion.		
No. 6—Gun Metal 88 Cu, 10 Sn, 2 Zn Cast		
Apr. 2, 1 p. m., to 5, 9 a. m.	5,000	10,000
Beam raised Apr. 3, 9 a. m.		
Apr. 5, 9 a. m., to 8, 9 a. m.	6,500	13,000
Beam raised Apr. 5, 12 m., 5 p. m.; 6, 9 a. m.		
Apr. 8, 9 a. m., to 14, 12 m.	8,500	17,000
Beam raised Apr. 8, 10 a. m., 11 a. m., 12 m., 2 p. m., 5 p. m.; 9, 9 a. m.; 10, 9 a. m.; 12, 9 a. m.; 13, 9 a. m.		
Apr. 14, 12 m., to 20, 9 a. m.	10,000	20,000
Beam raised continually until Apr. 15; then Apr. 15, 9 a. m., 11 a. m., 3 p. m., 5 p. m.; 16, 9 a. m., 3 p. m., 5 p. m.; 17, 9 a. m.; 18, 9:30 a. m.; 19, 9 a. m.		
Apr. 20, 9 a. m., to 22, 12 m.	11,500	23,000
Beam raised continually until failure occurred on Apr. 22, 12 m., by cracking. Crack near top.		

In order to discover what alloys are subject to failure by cracking all the usual copper alloys will be tested.

The stresses at cracking are as follows:

Kind of metal.	Stress at cracking, lb. per sq. in.
No. 1—Manganese bronze, plain extruded.	27,000
No. 2—Manganese bronze, plain extruded.	23,000
No. 3—Manganese bronze, plain extended.	23,000
No. 4—Naval brass, plain extruded.	20,000
No. 5—Muntz metal, plain extruded.	23,000
No. 6—Gun metal, cast 88 Cu, 10 Sn, 2 Zn.	23,000

It appears that the stress at which cracking occurs bears some relation to the elastic limit, but this relation has not yet been definitely established. Present results indicate that the metal is liable to cracking when the stress exceeds the elastic limit by 5000 lb. per square inch.

A detail report on the tests made is given in Table I.

Four specimens of manganese bronze have been under excessive stress for many months, but have been protected from corrosion. These specimens have not cracked. Some manganese-bronze studs which were found cracked in valves in the Catskill Aqueduct were made up with red lead. One test bolt, therefore, was embedded in red-lead paste and drawn up to a stress in excess of the initial yield point. In the part of the bolt where the red lead remained liquid the surface of the metal was stained and cracks appeared.

Two specimens of plain-extruded manganese bronze were corroded, one in ammonia, the other in a mixture of ferric

chloride and hydrochloric acid, and then broken in the testing machine. The specimens gave ultimate strengths of 65,300 and 60,000 lb. per square inch, and elongation of 43 and 42 per cent respectively. These results, which are quite normal, indicate that corrosion does not generally injure brass when it is not under stress while being corroded.

The results thus far obtained may be summed up as follows:

1. Prolonged excessive stress does not injure the metal when it is protected from corrosion while under stress.

2. Corrosion does not generally injure the metal when not accompanied by excessive stress.

3. Corrosion accompanied by prolonged stress less than 20,000 lb. per square inch does not generally injure the metal.

4. Corrosion by ammonia accompanied by a prolonged stress of 20,000 lb. per square inch or more causes cracking similar to season cracking.

5. The foregoing results apply to manganese bronze, naval brass, Muntz metal and gun metal.

6. No copper alloy has as yet been found to which these results do not apply. It is possible, however, that such exceptions exist, either on account of higher elastic limit or greater resistance to corrosion.

CONCLUSION

Practical experience with season cracking indicates that ammonia is not the only corrosive agent which causes cracking in overstressed copper alloys, but that the corrosion which results from the common conditions of exposure also produces cracking. Ammonia, therefore, may be regarded as a representative corrosive agent, although it attacks these alloys more quickly than the average exposure. The test with ammonia may be regarded as an accelerated test which in a few hours produces results which ordinarily would require days, weeks or months to develop, but which do not differ in kind from the results of the more common forms of exposure. Since all copper alloys in practical use are exposed to various corrosive agents it is probable that sooner or later all metal in use will be affected by corrosion, just as much as the test specimens

in the tests here reported. Therefore, it follows that the results obtained from these tests may be expected wherever copper alloys are permanently stressed over 20,000 lb. per square inch.

It seems, therefore, that we are justified in drawing the conclusion that forgeable brass and gun metal, and probably copper alloys in general, should never be stressed in practice to 20,000 lb. per square inch. In other words, 20,000 lb. per square inch should be regarded as the practical ultimate strength of this group of materials. The working stress should therefore be taken as a safe fraction of this stress, say 500 lb. per square inch.

An important corollary of this conclusion is that the process of manufacturing rods of copper alloys must be so planned that no appreciable initial tensile stress is left in the surface of the rod, and that the proper inspection of drawn rods must include strain measurements. Another important corollary is that copper alloys cannot be depended on where the stress is indeterminate, for in such cases it may or may not exceed the safe stress. These alloys, therefore, should not be used for important bolts when there is the least occasion for drawing them up very tight.

Fiber Helmet for Electric Welding

A helmet made of fiber board with a round lens about 5 in. in diameter instead of a square one is new for electric welding. The helmet is arranged to rest on the shoulders and is of one piece, laced in the back. The lenses are held in position in a leather ring fastened to the fiber board by four fiber bolts. There is no metal in the construction. It weighs 2 lb. The lens of the helmet is made up of a blue glass and a green glass, and the two are protected by a thin transparent or white glass in front to protect the more expensive glasses against pitting from the electric torch. The helmet may be removed from the shoulders and placed on the floor when the welder is through with the welding work, and the helmet is not liable to breakage.

We find your journal helpful in more ways than one.—J. B. Miller Keyless Lock Co.

QUESTIONS AND ANSWERS

All inquiries are answered in the order received and the answers published in the next regular issue whenever possible.

Uniform Colors Wanted

QUESTION No. 124.—We are sending you three single swing brackets. You will notice on Nos. 1 and 2 that the metal is red in spots. This only showed up when we dipped and lacquered them. In order to make them all one solid color, we endeavored to brass plate them as per sample No. 3, which after being hung in the drying oven for one-half hour came out all spotted. What we would like to know is how to make them a rich gold color like the tubing on sample No. 2.

ANSWER.—Your problem is rather intricate, inasmuch as you have several different factors entering into the trouble. A part of the bracket is rolled metal and part is cast. The cast portion is a different composition than the tube, which will always be a different color unless the composition is the same in both cast and rolled portions. The black spots at the end of the tubes are due to antimony in the solder, which is evidently of a poor grade. Regarding the spots on bracket No. 3, can say that these are due to alkali, either from wash or cyanide solution which has not been thoroughly washed out before lacquering. With a little more care this trouble can be eliminated.

Described As Gilding Metal

QUESTION No. 160.—We are mailing under separate cover samples of some shells that have been submitted us, and that our prospective buyer describes as gilding metal. Will you kindly tell us the composition of this alloy, and whether or not it is more or less expensive than brass or copper?

ANSWER.—The analysis of these samples show the following proportions: Copper 88.80 per cent, zinc 11.11 per cent. You will note from above that samples are brass, so your second question does not need answering. Gilding metal is a

commercial name for a certain brass mixture.

Good Hot Galvanizing Mixture

QUESTION No. 147.—Please tell us of a good mixture for hot galvanizing, suitable for small steel strips, also the best way to treat the work before it is galvanized.

ANSWER.—It is best to treat work before galvanizing by using muriatic acid dip. For hot galvanizing, melt a good grade of spelter, and add about one-eighth by weight of tin. Sal ammoniac is good sprinkled on top for a flux.

Lacquer, Also Gloss Oil

QUESTION No. 158.—Can you furnish us with formula for gloss for bronze and aluminum powders; oil that would make a hard finish and dry quickly. We also wish to know of a lacquer that is used in United States for salmon cans. It is of a brown shade and we think it takes the place of the linseed oil finish. The lacquer we want is to be used after the can is filled, and would have to be dipped; it should be light in body and quick drying. We understand that there is an asphalt lacquer, and also one made from a treated rosin.

ANSWER.—A cheap lacquer would probably be most suitable for your purpose. The powders can be mixed with it. We don't know exactly just what lacquer is used for salmon cans, but believe you can make something similar by dissolving white shellac and alcohol. Possibly some other gum such as Damar dissolved in spirits of turpentine would answer.

A Dull Black Finish

QUESTION No. 183.—We are sending you a metal stamping and wish to ask

for a formula for a dull black finish applied to this piece.

ANSWER.—A black nickel will be the best for your purpose. This can be made as follows:

Double nickel sulphate..... 8 oz.
Ammonium sulphocynate... 2 oz.
Zinc sulphate..... 1 oz.
Water 1 gal.
Use 1 volt.

Solution Comes Through

QUESTION No. 137.—We are having some trouble with our silver plating on German silver. After the work has been finished and carried in stock there appears on the surface spotted marks that have the appearance of solution coming out of a pin hole and staining the surface a gray color.

ANSWER.—Your trouble is undoubtedly caused, as you say, by the solution coming out. The only way to avoid this is to wash work more thoroughly before lacquering.

Silver Acid Strip

QUESTION No. 142.—We would like to have information in regard to silver acid strip. We strip a lot of knives, forks and hollow ware and have thrown down the silver from the acid with a saturated salt solution, but find that it does not all settle. Could you give me the reason.

ANSWER.—In all probability your acid strip does not contain enough free acid. Add a little nitric acid until the solution turns litmus paper red. Then add your salt.

Who Knows?

QUESTION No. 143.—A concern in Cincinnati is putting out plating outfits in which melted metal is employed in finishing. Would ask if you could give us some idea of the ingredients contained in the metal used? Is the process practical?

ANSWER.—We are not familiar with the process.

Platinum Jewelry That Turns Dark

QUESTION No. 144.—I should like information regarding the made-up platinum jewelry that in course of time turns dark inside. Is there anything in the way of acids, or whatever it may be, that by boiling out it would become white again.

Washing will not do any good. It takes something that would touch it stronger than that. I do not mean that the outside of the platinum work tarnishes; it is the sawed-out work, the inside of which gets sort of dark. How to restore them to right color is what we are desirous of knowing.

ANSWER.—If your platinum is pure it ought not turn dark. Try soaking it out in strong nitric acid. This may restore the original white color.

Hardening Lead

QUESTION No. 193.—If it was desired to harden lead, what chemical ought to be used?

ANSWER.—Lead is always hardened by the addition of antimony, from 10 to 20 per cent of antimony being used. Lead may also be hardened by the addition of metallic sodium, but is not stable. Antimony is the best hardener.

Polishing Paste for Aluminum

QUESTION No. 189.—I would like formula for a paste to remove discoloration that shows on insides of aluminum utensils; also a polish to brighten outsides of same. I wish to avoid, if possible, the red-colored polish.

ANSWER.—The bright dip that is used for aluminum consists of:

Water 1 gal.
Sal soda 6 oz.
Caustic soda 2 oz.

A polishing paste should consist of equal parts of salaratus and pumice stone. If a still brighter polish is desired, the articles may be finished with precipitated chalk.

Dark Finish on Bronze Metal

QUESTION No. 188.—Please give formula for obtaining a dark finish on a large statue of bronze metal.

ANSWER.—The statue should first be thoroughly scrubbed clean, then it should be brushed over with a pickle composed of oil of vitriol, one part; cold water, twelve parts. Then while the statue is still wet it should be brushed with a solution composed of ammonia hydrosulphide solution, four ounces per gallon of cold water, alternating applications of the pickle and the sulphide solution until the color is dark enough.

Finish by drying off and rubbing down with yellow wax and turpentine.

Salt peter

QUESTION No. 180.—How do you use salt peter dip?

ANSWER.—The salt peter dip should consist of about 8 oz. of salt peter dissolved in a gallon of hot oil of vitriol. If any water is added the silver will become very rough. Four ounces nitric acid can be used instead of the 8 oz. of salt peter. A stoneware crock is used to hold the dip.

"McKinley Gold"

QUESTION No. 191.—Please give the latest formula for McKinley gold. We have to apply it on small clock trimmings.

ANSWER.—"McKinley gold" is nothing but a very yellow brass deposit. A rich yellow brass should be made as usual, then add 4 oz. of bisulphide of soda to each gallon, to allow a high voltage to be used without coating over the anodes. Several firms resort to the use of golden lacquers to obtain the yellow color.

Stain for Acid Green, Dip, etc.

QUESTION No. 181.—I would like a receipt for stain as shown by color of sample sent; also a receipt for making acid green.

ANSWER.—The finish on the sample sent to us was obtained by the use of a lacquer, and if you will send it to any responsible lacquer concern we feel sure you will be able to get a lacquer that will duplicate finish of the sample. The acid green dip is composed of:

Sulphate of copper.... 12 oz.
Common salt 2 oz.
Hot water 1 gal.

The work should be bright dipped first; then dipped in the green dip for a few seconds, and then dipped in cold water. If the color is mottled or otherwise unsatisfactory, the dip should be repeated.

Processes Wanted

QUESTION No. 192.—Please give processes for the following:

Gray oxidizing on silver articles; also on brass articles.

Kahki-color on brass articles—all of

these by immersion only. If this cannot be done by immersion, please explain process.

ANSWER.—Formula for oxidizing silver:

Liver of sulphur..... 3 oz.
Aqua ammonia 2 oz.
Hot water 1 gal.

Brass oxidizing:

Water 1 gal.
Cyanide of potash..... 7 oz.
Arsenic trioxide 4 oz.

Khaki color on brass:

Acetate of copper, from 6 to 12 oz. per gallon (boiling water, according to color desired and per cent of copper brass contains).

To Obtain Copper Crystals

QUESTION No. 178.—How can I obtain copper crystals? We clean a quantity of copper wire in sulphuric acid, and also find we can coat steel wire in the bath. If we could make the bluestone it would be a great saving.

ANSWER.—The sulphate of copper crystals is obtained by evaporating the dilute sulphuric acid in a stoneware tank until the sulphate of copper forms the crystals that are commercially known as bluestone. As the selling price of bluestone runs from three to four cents per pound, it would not pay to save the crystals unless 200 or 300 lb. could be saved daily. The extra expense in evaporating tanks and labor will amount to more than you would get for your sulphate of copper.

Formula for Yellow Brass Solution

QUESTION No. 186.—We are about to put in a cold brass solution and we wish to know if you have any information in regard to same, also at what voltage this would be run? Do you know of any pickling solution which can be bought to do away with the necessity of using sulphuric or any other kind of acid, as this is dangerous to our men and just now is very difficult to get? For these two reasons we should like to use some other method. If you can advise us of anything which will remove scale and rust from strip steel in coils or in 10-ft. lengths we shall be very glad to hear from you.

ANSWER.—A formula for a yellow

brass solution that is meeting with great favor is as follows:

Water 1 gal.
Cyanide of copper..... 5 oz.
Cyanide of zinc..... 2 oz.
Cyanide of potash..... 9 oz.

Aqua ammonia until the desired yellow is obtained (about a pint for each 50 gal. of solution). The color of the deposit can be regulated to a large extent by the voltage, and should always be used at the point where the deposit is the same color as the anodes. From 3 to 5 volts is the usual range.

The rust and scale can be removed from the steel coils by making them the anode in a hot solution composed of 6 oz. of saltpeter and 2 oz. of common salt, per gallon. The steel must be dipped in a cyanide wash, then dipped in a soap wash, then in hot water and dried at once.

Scrap Zinc Shrinkage

QUESTION 185.—We would like to know how to keep the shrinkage of scrap zinc down. We smelt the zinc to make spelter and find a loss of 20 per cent in weight. This loss is in the form of dross or skimmings. We melt in an iron pot.

ANSWER.—We are unable to advise you as to whether your loss is running abnormally high, as we have no idea what kind of scrap you are smelting. If the material is thin sheet zinc corroded you must expect a high percentage of loss. If the dross is dry and powdery it is not likely that you can get any more metal out of it, but if it is pasty stir in sal ammoniac, and if this does not change it to dry dross skim off the pasty mass and save it until there is enough for a charge, when it should be melted, and a mixture of raw potatoes, sulphur and leather scraps should be introduced by means of a phosphorizer to clean the zinc of impurities. When the metal is liquid it is treated with 0.5 per cent of an alloy of zinc 95 per cent, aluminum 5 per cent.

Don't Use Molasses

QUESTION 196.—We are making small buckles which we have been casting solid and drilling the holes for the steel pin. We have been informed, however,

that we can cast the holes in by using a steel wire dipped in molasses. As we have never heard of molasses being used in this connection before, we would like to have your opinion thereon. We are aware that coatings of either plumbago or sand can be used on chills, but have never heard of molasses being used alone.

ANSWER.—We do not advise the use of molasses as a coating for steel cores, as we cannot see where any advantage would obtain from its use. It would be just as easy to mix plumbago with molasses water and use this as a coating as to use molasses alone. Steel pin cores are best coated with fine sharp sand glued on with glue water or linseed oil. We doubt whether the insertion of steel cores would be any cheaper than drilling. The patterns would have to be remade with coreprints as an initial expense, and when the time consumed in setting the cores and extracting them is taken into consideration the net result, we believe, will be a loss compared with the present practice.

To Prevent Metal Smoking When Poured

QUESTION 198.—I have been working on aluminum for some sixteen years and now work on brass, generally scrap brass. The castings run from one to twenty pounds in weight and are not always as satisfactory as I would like them to be. How can I prevent the metal smoking while it is being poured into the molds? Also, what will prevent scabs on the top of the casting? Is it best to pour it hot or cool, with a light or a heavy gate?

ANSWER.—Brass always smokes while being poured and the only way this can be prevented is by the addition of aluminum, about two ounces per hundred pounds of brass. If the castings are light and not likely to shrink it would be well to try this method. It is understood, of course, that the metal is yellow brass and not red brass with high zinc content, as it would not be advisable to add aluminum to this latter metal. If the castings are yellow brass that must withstand pressure, the aluminum cannot be used, also if they are likely to run dirty or shrink. Regarding this judgment must be used. Scabbing generally comes from ramming too hard—ram softer over the patterns. If aluminum can be used, pour

cool. If aluminum cannot be used, pour hot, though not at boiling temperature, and keep the heads full of metal while the mold is filling, even if some is spilled on the floor. Yellow brass must be poured with decision, and the molds over the tops of the patterns must be rammed lightly.

Trouble with Nickel Alloy

QUESTION 191.—We have had trouble lately with our 18 per cent nickel alloy, the metal being spotty when rolled. The formula used is the regular 18 per cent German silver.

ANSWER.—The difficulty is caused by the absorption of carbon or oxygen or both. Oxygen can be eliminated by the addition of manganese added in the form of manganese copper, commencing with 0.25 per cent of a 30 per cent manganese copper and increasing to 0.5 per cent should the first mentioned amount be found insufficient. Carbon is absorbed from the crucible, and a few tenths of a per cent makes the alloy hard. The remedy is to melt in a clay-lined crucible, which is obtainable from the regular crucible manufacturers.

Semi-Rustproof Blue or Black Finish

QUESTION No. 177.—We make a line of ranges of cold-rolled polished angle iron, and want a process to eliminate rust. Lacquer assists greatly, but when range heats lacquer discolors and finally burns off. The bright angle iron also discolors. We are experimenting with a view to blueing the bright-finished parts. Is there a process to do this easily?

ANSWER.—The process that is used for a semi-rust proof blue or black finish by manufacturers of popular priced baby carriages and telephone arm extensions, etc., is to cover the polished iron with a thin paste composed of sulphite of antimony and turpentine. After the paste has been applied it is "burnt-in" with a very hot blaze. The article is finished by rubbing down with thin oil or turpentine. It is almost impossible to govern the color obtained by this process, as it varies from blue to black.

Blueing Gun Barrels by Hand Process

QUESTION No. 179.—Please publish formula for blueing gun barrels by hand process, with manner of manipulation.

ANSWER.—There are several preparations on the market for "blueing" guns, bicycle parts, etc., but the only lasting blue is the one obtained by heat. See question No. 177.

Rust on Knives—Standard Tests

QUESTION No. 173.—Stripping knives in cyanide they sometimes rust. We have the current well under control. I make and operate all solutions, but cannot analyze silver solution for either cyanide or silver. I believe you make up a nitrate of silver solution with a given amount of silver to a litre of water as material for cyanide test. I would like the standard method of testing for both silver and cyanide.

ANSWER.—The rusting of the knives is due to the fact that during electrolysis, hydrogen gas is liberated at the cathode and oxygen gas is liberated at the anode. If a high voltage is used such a large amount of oxygen will be discharged that it will attack the steel, forming oxide of iron. An accurate method of testing the solution for silver content is to evaporate one quart of the solution to dryness. Then mix the dry salts with an equal part of sal ammoniac and melt in a crucible. The silver obtained will weigh 5 dwt. for each ounce of silver per gallon. A test for free cyanide requires considerable skill and special apparatus, and it is always more satisfactory to have such tests performed in a regular laboratory.

Plating Inside Brass Cups

QUESTION No. 201.—Please publish approved method for plating inside of brass cups as per sketch sent ranging from 2 to 6 in. diameter, and 2 to 8 in. deep.

ANSWER.—If the cups are wired in such a way that open ends are tilted slightly upward, allowing the hydrogen gas to escape and the impoverished solution to flow out, you will have no trouble in plating the inside of the cups, provided your solution is up to standard. The solution should be rich in nickel and should contain a good conducting salt, preferably about 3 oz. Epsom salts per gallon. If you still have trouble in covering the edges of the bottom, try heating the solution to about 130° F.

The Abuse of System

By JOHN CALDER*

We *organize* in order to *manage* a business undertaking and we *manage* it through *system*.

It is a weakness in any business if the responsible executives are unable to give on demand a satisfactory account of how it is supposed to function, and we owe a debt of gratitude to those who, during the last decade, have brought to the front the issue that we must always know clearly three things, viz., whom we have to co-operate with, what we have to manage, and how we are supposed to accomplish the work. This knowledge, in proportion, should reach down to the performer of the humblest tasks. It may be accepted as a general rule that proper selection and instruction of the human factors in organization and management will lead sooner or later to a systematic functioning which will be a natural outgrowth of the needs of the business, while unvitalized red tape will always prove ineffective.

There is no magic about system, no matter whose name may be attached to it. It is no pink pill for pale plants. System is simply organized common sense. If a system for anything is so involved that its material elements cannot be easily comprehended, have nothing to do with it.

Set it before you as an axiom that no system is worth any more than it can earn. There are systems of doing things in certain plants to-day which are most ingenious and interesting and yet undesirable from the point of view of profit making. There are systems constructed with rejoicing and lax scrutiny in the years of plenty which are to-day eating off their heads because they have no reducing expense of operation for lean times.

The first question which the experienced investigator usually puts, to himself at least, after all the facts are on the table is not what systems did they have or not have, but "Is the business worth while anyhow?" This is no idle question either. Not a few systematizers have labored valiantly over plants and

made sincere promises of betterment which were wholly negated on the balance sheets because the businesses, irrespective of the systems in use, were inherently unprofitable ventures and could have been readily classified as such with a fraction of the energy spent in spinning the web of a new system around them.

Reaction May Go Too Far

On the whole the tendency has been to over-elaborate detail without regard to its profit-making utility in the premises; to construct ornament rather than to ornament construction; to design systems on expensive foundations strong enough to carry a great deal of business that does not exist and never will exist. A decided reaction is now setting in which should not be allowed to go too far. Too few people realize to-day on what remarkably small margins many businesses which prosper slowly are carried and could not stand the infliction of new, elaborate and costly plans of operation which guarantee no expansion of trade to justify them.

Undoubtedly we have gained much ground, particularly in specific details of system, but we have also at times been unable to see the forest because of the trees. Take, for instance, the system known as scientific management, which will remain as a monument to its gifted founder. This system has very broad and exclusive claims and insistent detail. It is the best articulated of all the competing systems of business oversight, but it is not the most effective and economical scheme for solving a number of business and industrial problems on which it has been tried. Nor was a trial at all necessary to prove this, and scientific management has suffered because its limitations have not been recognized and its costly functionalization thrust upon small irregular industries not able to take full advantage of it.

In many of our businesses to-day the margin of profit is so small, the labor items so low a factor in the total cost and the work of a few practical executives so economical that it would be folly to inflict upon them in the name of science a more expensive and less efficient routine. Exponents of scientific management have been known to hold that such businesses are inherently weak and should not exist;

*From a paper read before the Efficiency Society.

but science implies action in accordance with the facts, and no system should be permitted to be an end in itself, but should submit at all times to the commercial test of profitableness.

Remedies Suggested

Now what is the remedy for unwise systematizing? It is twofold. First, while holding the chief executive of a business wholly responsible for permitting momentous changes in system it is always wise to give his subordinates a chance to offer suggestions on a given plan of outside origin. If this is done the proprietors will be surprised at the number of things they assume about their business which are not so. A passion for facts should override all other considerations, even our most cherished ideas of system detail. The professional systematizer is not guiltless, for, having obtained the ear of the proprietor of a business he has sometimes ridden roughshod over the experienced executives, alienated their support, and pulled up finally a goodly distance along the wrong road to the ultimate discrediting of perfectly sound ideas propagated unfortunately by injudicious and unmannerly agents.

The second aid to correct perspective in applying system is a sound apprehension of what the scientific method essentially is and of its possibilities and relation to the varying factors of business, which is an art rather than a science.

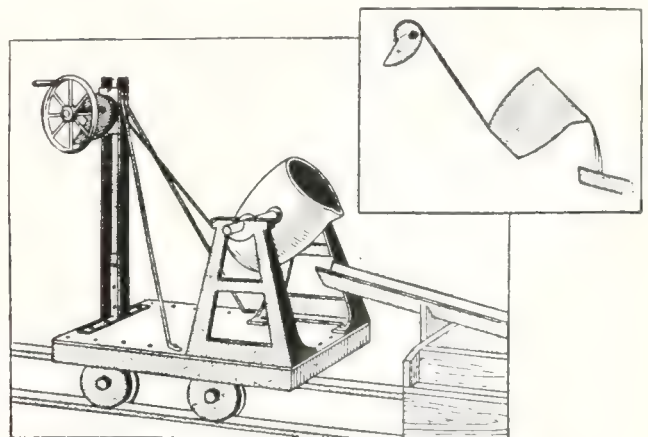
The ability clearly to perceive and avoid inutility in such research is frequently absent in men who are permitted to systematize without thorough business experience. In all such cases wise, capable managements will save time and money by avoiding any attempts to establish a science for irreconcilable variables or infrequent phenomena and will fall back upon an empirical but none the less "common-sense" solution of the problem. This necessity does not reflect upon the scientific method, which must always face very different conditions in industry and commerce from those met with in nature, and must constantly yield to and be measured solely by considerations of ultimate utility, of available capital and of current product and profit.

Hitting High Spots of Inefficiency

In conclusion let me point out that in facing the actual problems of industry with full appreciation of what the scientific method might accomplish under certain conditions it is not as a rule necessary or advisable to go into minute details before systematizing actively to some extent. A very comprehensive system takes much time and money to formulate and is rarely born made to order. The responsible executive is called upon to produce rather than to ponder, and if he is wise he will hit the high spots of inefficiency and lack of system at relatively low cost and without delay, leaving the refinements to a later date and probably postponing some of them indefinitely.

New Device for Tilting Hot-Metal Ladle

Tilting a ladle so that the molten metal will be poured in an even and smooth stream is an operation requiring



Molten Metal is Poured from the Ladle in a Uniform Stream

much skill when done by the usual method. An ingenious device recently patented is designed to do this mechanically. The ladle rotates on fixed bearings, as shown, and is tilted by a cable attached to the back. The feature of the invention is that the cable passes over a cam which rotates at a uniform speed. As the cable is wound on the cam the speed of tilting gradually increases so that the rate of flow from the spout of the ladle is exactly the same at all stages of the process of emptying—Popular Mechanics.

Autumn Meeting of the British Institute of Metals*

The autumn meeting of the British Institute of Metals was held in the rooms of the Chemical Society, Burlington House, London, Sept. 17. The president, Sir H. J. Oram, K. C. B., was in the chair.

In opening the proceedings, the president explained that the plan adopted last year, owing to the war, of holding only a statutory meeting and of inviting discussion of a number of papers by writing was not regarded as particularly satisfactory, and it was thought better this year to hold an evening meeting and orally discuss some papers.

After the reading of the minutes, the election of officers and Council was held as follows: President, Dr. G. T. Beilby, F. R. S.; vice-presidents, Prof. H. C. H. Carpenter, J. T. Milton and Sir T. K. Rose; honorable treasurer, A. E. Seaton; members of council, L. Archbutt, G. Bean, G. Hughes, Dr. R. S. Hutton, Sir Charles Parsons, W. Weir and W. M. Morrison.

The first paper was "Specifications for Alloys for High Speed Superheated Steam Turbine Blading," by W. B. Parker. In the discussion Prof. A. K. Huntington welcomed the paper as one out of the ordinary groove, and expressed the hope that further similar practical papers would be presented to the Institute. The questions of yield point and elastic limit were frequently the subject of much heartburning in manufacturing plants. The English War Office and the Admiralty generally called for an extension 0.003 on 2 in. at some particular specified load, and that appeared to be the most rational way of dealing with the point, rather than talking of the elastic limit or yield point.

Dr. Walter Rosenhain thought the author had rather overlooked the work of the National Physical Laboratory in connection with methods of testing and specifying these alloys, and also as regards elastic limit. It was true this work had been done on steel, but that did not matter. The author should be cautious in advancing definitions of elastic limit differing from those of the Engineering

Standards Committee which were in general use. The mere fact that a metal differed in its physical properties—as some of these alloys did compared with steel—did not justify completely different definitions of the physical constants. "True elastic limit" had already received a quite definite meaning, which was very different from the elastic limit indicated by the author. What was wanted for non-ferrous alloys, was not standardized terms, which existed already, but standardized methods of testing. Perhaps one of the Institute's research committees might find useful work in this connection. As to new alloys, he suggested nickel-cobalt, nickel-chromium, and nickel-cobalt chromium. Some of these possessed remarkable properties and were non-corrodible.

Dr. O. F. Hudson said the difficulty was that the testing of non-ferrous alloys was always considered from the viewpoint of testing steel, but the same conditions did not hold.

Mr. Arnold Philip spoke on the question of the erosion of turbine blading, and asked the author to show him actual specimens. Had deposits been discovered on the blading? Upon some specimens from electrical works, considerable lime had been found in the deposit, which he attributed to priming.

Prof. C. A. Edwards said that a steel with which he had been experimenting, contained 6 per cent chromium and about 0.65 per cent carbon and was perfectly malleable for ordinary manufacturing purposes. It could be hardened much more readily and gradually than carbon steels, and could be tempered to any degree of hardness, which would be quite permanent up to about 600 deg. C., approximating to a Brinell test of 450. Even more important, perhaps, was the point that it was non-corrodible. This was the steel that was now so largely used in the production of non-rusting or stainless cutlery. He thought it would be suitable for turbine blades.

Prof. T. Turner said that while the author had told us what was wanted in a turbine blade, he had not pointed out exactly how the results could be obtained with non-ferrous metals.

Mr. J. T. Milton observed that all reference to yield point and elastic limit

*Report of meeting is from *The Ironmonger*, London.

should be left out of a commercial specification. With regard to bridge and boiler materials, the Engineering Standards Committee had wisely left out any such reference in their specifications.

The president, who is an Engineer Vice-Admiral, stated that in the navy at present there was practically no trouble with turbine blading. It was necessary to avoid using salt water, and also not to use superheat.

Dr. O. F. Hudson then presented a paper on the "Influence of Tin on Brass," which was followed by one by Prof. C. A. Edwards entitled, "Metallic Crystal Twinning by Direct Mechanical Strain," which was productive of considerable discussion.

In opening the discussion, Dr. Walter Rosenhain said that in this paper the author had given the proof required that in certain cases metallic twinning takes place by direct strain. Beyond that the whole matter was very largely a question of speculation and, to some extent, imagination. The question of what really happens when a metal undergoes plastic deformation had interested him for some years, but, although the evidence up to a certain point was conclusive, there was always the possibility of different interpretations being put upon it. It was said that slip might always be accompanied by twinning, but the evidence was distinctly against that; yet, when we considered what the crystal structure was like, it was obvious that the possibility existed. Probably more interesting was the question whether that change of structure was accompanied by internal disturbance of the crystalline arrangement, particularly over the surfaces on which twinning occurred. Dr. Edwards took the view that there was a considerable amount of disturbance, and that was not an irrational view. There were, however, two or three answers. If there were such disturbances, the twinned material would be appreciably harder than the untwinned, particularly immediately after twinning, and to some extent even when the strain had been removed by subsequent annealing.

As regards the twinned position being unstable as suggested by Dr. Edwards, he disagreed with that view. In the case

of annealing twinned material, the twinning tends to increase at first, and annealing must take place at a high temperature, very close to the solidus. If the material were unstable, the twinning would disappear rapidly when the temperature was raised. There was evidence that the twin boundary was not the same as the crystal boundary. When heating metal in vacuo there were distinct changes around the surface of slip, but at the twin boundaries as such there was not the same action.

Prof. H. C. H. Carpenter asked whether Professor Edwards knew of a definite method of distinguishing between a slip band and a twin.

Professor Edwards, replying, said that Dr. Rosenhain had materially cleared up the difference of opinion which had existed between them hitherto. They seemed to be now virtually in agreement. The question of whether it was possible to determine whether a slip line was a twin or not was one upon which he did not like to be very definite, but all the evidence might be taken as equally applicable to either case. The only objection was that the same effect was obtained after polishing and etching—i.e., the mere act of polishing when there were minute twins, such as slip lines might be supposed to be, might develop quite sufficient heat to remove that excessively minute twinning.

Dr. Rosenhain reminded the author that certain photographs of the section of slip bands which were published years ago were not quite consistent with that view.

Professor Edwards thought it was a question of the power of magnification. The twinning was so minute that it was virtually the next stage to a slip. Even the microscope was not sufficiently powerful to define molecular dimensions of that sort. The question of stability was a minor point, and he wished to indicate that a twin crystal could not really be regarded as a stable condition of affairs because there was a tendency for twinning to disappear. If it were stable it would be permanent.

Other papers presented were: "A Thermostat for Moderate and High Temperatures," by J. L. Houghton and D. Hanson. "Notes on the Copper-rich

Kalchoids," by S. L. Hoyt of Minnesota, and H. M. P. Printon of Arizona. "The Micro-chemistry of Corrosion," by Cecil Desch. "Structural Changes in Industrial Brasses," and "The Hardness of Copper-Zinc Alloys," by Dr. D. Meneghini of the University of Padua, Italy. Also "The Physical Properties of the Metals as Functions of Each Other," by A. H. Stewart, and "Detection of Internal Blowholes in Metal Castings by Means of X-rays," by C. H. Tonamy, a Japanese engineer.

The unanimous opinion of the meeting was that it was a great success. The idea of improving upon a formal war-meeting was justified, and the two hours of discussion in the evening, followed by light refreshments and conversation on somewhat less serious subjects, were thoroughly enjoyed by all who were present.

Alcohol Blowtorch for Difficult Soldering

To solder in close places, I have found the device illustrated quite convenient, as it leaves both hands free to handle the object being soldered. Two pieces of spring brass, about 3 in. long and $\frac{1}{4}$ in. wide, are bent to the shape shown at A and clamped together with a screw taken



Clamps for Holding the Alcohol Receptacle on the End of the Blowpipe

from a dry cell, as shown at B. This device clamped to the blowpipe end and fitted with a tube, such as used for holding pencil leads, filled with a wick saturated in alcohol, completes the blowtorch. It makes an excellent tool for small work, as the hands are free to hold the parts to be soldered in place.—Popular Mechanics.

Metallic calcium is an excellent conductor of heat. If a small piece about 1 in. square by $\frac{1}{2}$ in. in thickness is placed on the back of the hand and a little water is dropped thereon, the metal will decom-

pose the water and such an amount of heat will be generated that the calcium will soon become too unpleasantly warm to be retained on the hand, and will be quickly dropped. The heat generated by the reaction is immediately conveyed from the spot where the drop of water was placed to all parts of the calcium, the entire piece becomes uniformly warm from the reaction set up by one drop of water, while several drops make it hot. The experiment is devoid of all danger as the calcium does not seize upon the oxygen with sufficient avidity to en-flame the hydrogen which is set free by the reaction.

Tin is a soft and ductile metal capable of forming alloys with all the commonly used metals in the brass foundry. It will alloy with lead, zinc, copper, iron, aluminum and antimony, but does not exercise the same effect upon each. Thus when alloyed with copper, it rapidly hardens the latter, with 15 per cent tin and 85 per cent copper, a very hard alloy is formed having little ductility, but with lead 15 per cent of tin exerts no particular hardening effect, and the same remark applies to zinc and aluminum. Indeed an alloy of aluminum 85 per cent and tin 15 per cent brinells only 23.3 against 25 for pure aluminum.

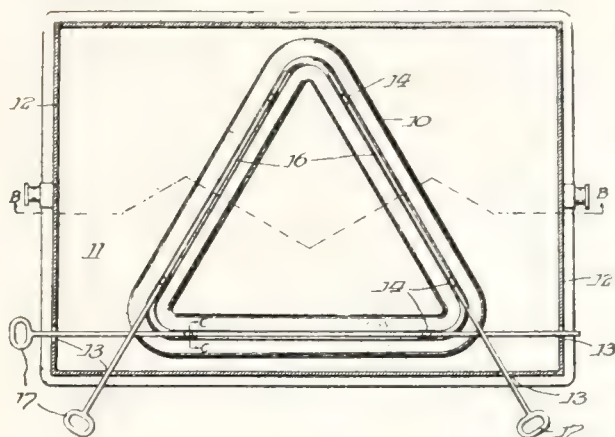
James G. Hendrickson

Mr. Hendrickson, the late president and founder of The Ajax Metal Company of Philadelphia, passed away on Nov. 4. He was unmarried and a sister survives him. He was 69 years old. The cause of death was a paralytic stroke.

He established the Ajax Metal Company in 1880. Something over a year ago he retired from the presidency of the company and since then has been chairman of the board, also chairman of the Board of Directors of The Ajax Metal Company of the South, Birmingham, Ala., and president of The Ajax Lead Coating Company. He was a Mason, member of the Union League Club of Philadelphia, member of the Sons of Delaware, and was buried in the family mausoleum in the Wilmington and Brandywine Cemetery, Wilmington, Del.

RECENT PATENTS

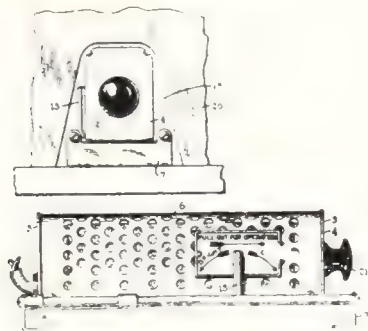
Apparatus for Venting Molds



1. The method of molding which consists in placing a pattern in a flask, locating a venting tool in proximity to and in substantial parallelism with an edge of the pattern, ramming sand around pattern and between tool and pattern, removing pattern and tool, tool being withdrawn lengthwise to provide a vent opening along side and parallel with the pattern and out of communication with the casting space.

(U. S. Patent 1,157,847, April 22, 1914. Serial No. 23,038. J. C. Davis, Hinsdale, Ill., assignor to Am. Steel Foundries Co.)

Rheostat



This shows apparatus having insulated base on an elongated frame, a cover secured to the frame, also a controlling member pivoted to it, and movable over the resistance, the member having an operating part without the cover and near to one end of the frame, with terminal connections at other end of frame. The supporting frame has a pair of mounted insulating brasses in spaced parallel relation, resistances on the bases, the controlling member movable over a limited portion of the resistances. A resistor provides a fixed, also regulating resistance.

(U. S. Patent 1,158,052, Feb. 20, 1915.

Serial No. 9545. A. J. Horton, White Plains, N. Y., assignor to Cutler-Hammer Mfg. Co., Milwaukee.)

Method of Melting and Spraying Fusible Substances



The apparatus described is for melting and spraying a fusible substance by subjecting it to a blast of unignited, chemically neutral gas heated to above the melting point of the substance, at a high enough pressure to disintegrate and project the substance while melting, and directing a separate blast on the fused part of the substance.

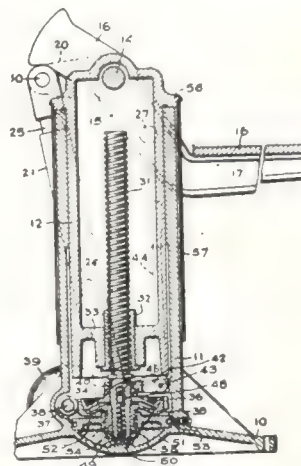
(U. S. Patent 1,157,984. Original March 31, 1914, divided and this application filed July 6, 1914. Serial No. 849,211. F. Herkenrath, Zurich, Switzerland, assignor to Metals Coating Co., Boston.)

Electric Welding and Fusion-Deposition of Nitrid

An aluminous material (bauxite mixed with carbon) is sent into a flame produced by the combustion of coal dust, the quantity of air for burning being chosen in such a way that the combustion gives almost exclusively carbon monoxid.

(U. S. Patent 1,143,482. Feb. 2, 1915. Serial No. 5,793. Adrian Badin, Paris, France.)

Molding Machine



Combination of a rock-over molding machine, a hinged mold table, elevator

device to raise table to hinge, power to operate elevator, and manual means for controlling elevator. There is a vertically movable plunger connected to hinge of table, engaged with a screw rod, power shaft and manually controlled friction clutch between shaft and rod, also friction device for transmitting power to a jack screw device that elevates plunger, used for braking its descent.

(U. S. Patent 1,157,967, Sept. 25, 1912. Serial No. 722,258. G. E. Stevens, Lynn, Mass., assignor to General Electric Co.)

A method of coating steel or iron with copper invented by J. E. Sheaffer, Burnham, Pa. (U. S. Patent No. 1,115,870, Nov. 3, 1914), makes a hollow copper ingot by pouring out the center after the outer crust has solidified, after the slush method of making zinc castings. The hollow ingot of copper thus formed is then filled up with iron or steel, yielding a compound ingot that can be rolled or drawn.

Patent Litigation

Sufficient time has now elapsed since the promulgation of the new rules of practice of the Courts of Equity of the United States on Nov. 4, 1912, to determine the effect of these rules, according to George H. Benjamin.

The first effect noticeable is that patent litigation has materially decreased. This is undoubtedly due, in part, to the unfortunate business conditions which have prevailed for the past four years, and in part to the fact that the average patent lawyer was at first totally uninformed as to how to prepare the requisite bill of complaint or answer and present his case to the court. This lack of information has, in many cases, led lawyers to advise their clients not to proceed with litigation for the time being.

The second effect, where suits were presented to the court, was the great reduction in the time usually consumed in the examination and cross examination of expert witnesses, thereby effecting a very considerable saving to the client and permitting the case to be brought to a conclusion in a much shorter space of time than was previously required.

The third effect was to enable contestants to obtain the opinion of the judge hearing the cause, as derived by him from hearing the examination of the witnesses in court, such an opinion being recognized by the lawyers as apt to be more just and equitable than one derived from reading printed testimony, where the character and the demeanor of the witnesses were unknown to the court.

The fourth effect was to take patent litigation out of the hands of professed patent lawyers, many of whom had no knowledge of law excepting such as related to purely patent questions, and put it in the hands of general lawyers. Practice for the last two years has demonstrated that a case placed in the hands of a competent general lawyer, assisted by an expert familiar with the technical questions involved and capable of preparing a technical exposition and argument, has been more successful, both on the part of complainant and defendant, than the old practice of employing a patent lawyer, leaving him to hire and instruct an expert. It will be observed that the practice in the present case is just the reverse of that heretofore employed. Formerly, the patent lawyer instructed the expert; now the expert instructs the general lawyer as to the technical questions involved; the lawyer then applies the law and presents the matter to the court.

The fifth and perhaps the most important effect is that the present rules of practice not only decrease the cost of litigation, but effect more substantial justice. The owner of a good patent, be he poor or rich, can cheaply and readily obtain a judgment. Those having worthless patents, or corporations who use patents only for obstructive purposes, find to their cost that the methods heretofore prevailing for annoying and using up a competitor or destroying the value of a good patent in the hands of a poor man, are no longer possible.

Men who are workers in metals are in demand these days. The latest report of the Boston Free Employment Bureau shows that. It also shows that unemployment lessened in October compared with a year ago. The demand for help increased 38 per cent, and places were found for 34 per cent more than in October, 1914.

MEETINGS OF AMERICAN ELECTRO- PLATERS' SOCIETY

SUPREME SOCIETY

Meets at Toronto, Can., in July. Date not yet announced. Secretary, Walter Fraine, 507 Grand Ave., Dayton, Ohio.

BRANCH SOCIETIES

Bridgeport—Meets on the third Friday of each month at 260 John Street, Bridgeport, Conn. Secretary Nelson Barnard, 858 Howard Avenue, Bridgeport, Conn.

Buffalo—Meets the first Saturday of each month at the University of Buffalo, at 8 P. M. Secretary, S. Wroblewski, 1486 Elmwood Avenue, Buffalo, N. Y.

Chicago—Meets fourth Saturday of each month at 8 P. M. at Western Building, Randolph and Michigan Avenue. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

Cincinnati—Meets once each month at Denison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordman, 720 Froom Avenue, Cincinnati, Ohio.

Cleveland—Meets last Saturday of each month at Central Y. M. C. A. Secretary, Chas. Werft, 331 Strathmore Avenue, Cleveland, O.

Dayton—Meets first Wednesday of each month at Y. M. C. A., Dayton, Ohio. Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

Detroit—Meets first Friday of each month at Prismatic Hall, 140 First Street. Secretary, B. E. Miller, 543 Townsend Avenue, Detroit, Mich.

Indianapolis—Meets last Saturday of each month at the Denison Hotel. Secretary, Arthur Nelson, 1617 Shelby Street, Indianapolis, Ind.

Milwaukee—Meets first Friday of each month at Eagles Hall, 137 Second Street. Secretary, E. C. Yaeger, 962 Ninth Street, Newark, N. J.

Newark—Meets first and third Friday of each month, 8 P. M., 47 Bank Street, Newark, N. J. Secretary, Charles A. Stiehle, 46 West Madison Avenue, Irvington, N. J.

New York—Meets second and fourth Friday of each month at 258-262 Pearl Street, New York City, at 8 P. M. Secretary, Wm. Fischer, 345 East 23d Street, New York.

Philadelphia—Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts., Philadelphia, Pa. Secretary, Philip Uhl, 2432 North 29th Street, Philadelphia, Pa.

Rochester—Meets second and fourth Friday of each month at University of Rochester. Secretary, C. V. Haring, 603 Dewey Avenue, Rochester, N. Y.

St. Louis—Meets on the fourth Saturday of each month at Public Library Assembly Rooms. Secretary, F. Rushton, 4405 Blair Street, St. Louis, Mo.

Toledo—Meets every Wednesday at Toledo University. Secretary, James E. Nagle, 209 Navarre Avenue, Toledo, Ohio.

Toronto—Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box 5, Coleman, Ont.

Society Notes

The awarding of the Nobel Prize for Physics for 1915 by the Swedish Royal Academy of Science to Prof. W. H. Bragg, M.A., D.Sc., F.R.S., of University College, Gower Street, London, (jointly with his son), for an examination of the formation of crystals by X-rays renders of special interest the announcement that Professor Bragg is to deliver the 1916 May Lecture before the Institute of Metals (England). The May Lecturer is now devoting attention to the structure of metal crystals as revealed by X-rays, and it is expected that he will have a very important pronouncement to make on this subject before the Institute of Metals on the occasion of the forthcoming lecture.

The Cleveland Engineering Society met and discussed, Dec. 14, "Natural Gas in Ohio," by J. A. Bownocker, State Geologist.

The regular monthly meeting of the New York branch of the American Electro-Platers' Society was held at its rooms, 256 Pearl Street, Nov. 26. An interesting demonstration was made by the laboratory committee in producing verde antique finish by the sawdust method. The analysis of the silver solution was continued. The New York branch will hold its annual banquet on the evening of Feb. 19, 1916, at the Broadway Central Hotel.

At the latest meeting of the St. Louis Branch, A. E. S., the question of establishing a laboratory was considered. It was decided to defer the subject to a future date. In discussing the annual banquet it was agreed to introduce a new feature by inviting members and ladies to participate. Messrs. Duebelbers and Rushton were appointed the committee of arrangements. Date of banquet to be announced.

The Newark (N. J.) Branch, A. E. S., held an interesting meeting Nov. 5, at which a demonstration was given by representatives of the Roessler & Hasslacher Chemical Co. Messrs. Dittmar and Schneider were active in the matter.

The Philadelphia Branch, A. E. S., held its annual banquet Dec. 4 at the Windsor Hotel. A notable list of speakers attended, including Dr. Lukens of the University of Pennsylvania, Mr. Hadlow from the New York Branch, and the other speakers comprised Messrs. Fox, Woldstein, Backus and Schneider. It was a most successful and entertaining function.

New Publications

SCHOOL OF MINES QUARTERLY. Vol. 36, No. 3. Columbia University, New York.

The paper on "Recent Progress in Metallography" by William Campbell, Ph.D., D.S.C., is the one article in the current issue of this valuable quarterly publication that will interest many readers of this journal. The paper was originally prepared for presentation at the International Engineering Congress at San Francisco. It brings up to date the list of abstracts published in the *Quarterly*, July, 1912.

HENDRICKS' COMMERCIAL REGISTER OF THE U. S. FOR BUYERS AND SELLERS. Published by S. E. Hendricks Co., Inc., New York.

The twenty-fourth annual edition of this useful compilation is now issued. We are advised that the work has been most carefully gone over with the aim at the removal of all useless data, and a revision of the lists, name for name, in the interests of the most complete accuracy obtainable. The Register has been established since 1891 and has demonstrated its value by its usefulness.

SCIENTIFIC MANAGEMENT AND LABOR. By L. C. Marshall, Dean of College of Commerce and Administration. Press of D. Appleton & Co.

This is a study of efficiency, taking the subject through about all phases. It might prove valuable to employers who are in contact with such problems and are groping for a way out.

I enjoy reading the BRASS WORLD. It is a help to me.

GEORGE P. WELSH, Cleveland, Ohio.

TRADE NOTES

A remarkable showing is being made by the Acme Die-Casting Corporation, whose shops are in Bush Terminal in Brooklyn.

The company is using a new die-casting machine which eliminates all hard work and has interesting features. For instance, it may be regulated automatically as to speed and pressure as well as temperature, and needs only one man to run it. It is claimed that it uses more pressure than other machines and is capable of about five times the output of ordinary die-casting machines. Due to the method of construction it makes die-castings which are claimed to be practically perfect in finish and more accurate and solid in grain than have ever been produced. Shortly after this company introduced its product its orders taxed its capacity, and for a time it was necessary to refuse them. In November the capital was increased to \$200,000 (the original was \$125,000), more space was taken, additional equipment installed, and capacity greatly increased, enabling it to catch up with its work. The company makes die-castings in the usual zinc, tin, and lead alloys.

Edgar N. Dollin is president of the company, and the mechanical work is under the direction of George W. Bungay, vice-president of the company.

The Indiana Metal Novelty Company, Vincennes, Ind., has been incorporated with \$7,500 capital stock to make metal novelties. The directors are B. C. Amerine, G. A. Downey and J. E. Hartigan.

The Wadsworth Aluminum Company, Wadsworth, Ohio, has been incorporated with \$20,000 capital stock by W. C. Washburn, and others.

Plans are being prepared for the Du Pont Powder Company, Wilmington, Del., for an experimental mechanical laboratory, 90 by 110 ft.

A new firm, C. A. Danberg & Co., will build a brass foundry on Stanley Street, New Britain, Conn.

The Evans Stamping & Plating Company, Taunton, Mass., is asking bids on a foundry building.

A large building at Sixteenth Street and Second Avenue, Canton, Md., is being fitted up as a galvanizing plant for the Refractory Zinc Ore Treatment Company, 3 William Street, New York. A. W. Hahn will be in charge.

The Schneider-Bowman Company, Frankford Avenue and Vandyke Street, Philadelphia, Pa., will receive bids for an addition to its foundry, 18 by 76 ft., two stories, of brick construction. Stearns & Castor, Stephen Girard Building, are the architects.

The Tioga Machine Company, 2027 Estaugh Street, Philadelphia, recently incorporated, manufactures sheet metal dies and does general machine shop work. E. Walt Havens is president and C. M. Ayars is treasurer and general manager.

The Norwick Wire Basket Company, Norwick, N. Y., has increased its capital stock from \$25,000 to \$50,000. It has taken additional manufacturing space to provide for its increased business temporarily but is securing options and drawing plans for a building which it will erect. J. B. Turner is president and F. V. Fernald is manager.

The Atlas Brass Foundry Co., Columbus, has let contract for a three-story addition to its plant on South Park Street. Additional equipment will be added for the manufacture of automobile parts.

The Pierce-Arrow Motor Car Company, Buffalo, has let contract for erection of a laboratory and experimental building, 50 by 90 ft., two stories, at its plant at Elmwood Avenue and New York Central Railroad Belt Line.

The Keeler Brass Works, Grand Rapids, Mich., has begun the construction of an addition, 112 by 230 ft., one and one-half stories. It specializes in the manufacture of brass novelties and furniture parts.

The Oxy Acetylene Welding & Engineering Company, Atlanta, Ga., has been incorporated with a capital stock of \$90,000, by M. F. H. Keith, J. H. Simms, W. N. Tumlin and others, and will manufacture acetylene apparatus.

The National Copper Works, Boston, Mass., is a new corporation with capital of \$100,000. Morris Broomfield, Hubert H. Snow and John J. Connolly are the incorporators.

E. R. Corwin has purchased the machinery from the Sterling Electric Works, Lafayette, Ind., and will resume the manufacture of its products, supplemented by a new line of electrical devices.

The Bausch & Lomb Company, manufacturer of optical and astronomical instruments, Rochester, N. Y., has let contracts for the erection of an additional factory, 70 by 110 ft., one story.

The Aluminum Goods Mfg. Company, Manitowoc, Wis., will erect an addition to its factory, to cost approximately \$100,000 with equipment. It will be of steel and brick, with mill floors, five stories, 53 ft. 6 in. x 300 ft. Bids on the steel work will be taken until Nov. 6 by Earl F. Miller, architect, Dempsey Block, Manitowoc. The company is also planning to build a new warehouse adjoining its plant.

The American Knife & Shear Co., Waterville, Conn., is building a one-story addition.

At a meeting of the board of directors of the Hanson & Van Winkle Company, Newark, N. J., the following officers were elected: President, E. N. Todd; vice-president, R. D. Foster; treasurer, E. N. Boice.

The United Smelting & Aluminum Co., New Haven, Conn., is now in its new and spacious plant with exceedingly efficient equipment, including seventeen latest and best type melting furnaces, busy turning out aluminum ingots, alloys, etc. The progress of the company has been very rapid and sustained, and it is the satisfied customers that account for it, according to the company.

The James H. Stitt Co. has changed its office address from 185 Madison Avenue to 225 Fifth Avenue, New York City. The new quarters are larger and better adapted to the needs of the business.

A brass and aluminum foundry at Lima, Ohio, is now building. The management interests will be represented by C. S. Reinholt.

Work has been commenced on the new tin-plate mill at Gary, Ind., to be operated by American Sheet & Tin Plate Co.

The Bristol (Conn.) Brass Co. has begun the excavation for its addition to plant.

The Northern Brass Co. at Whitinsville, Mass., has been incorporated for \$15,000. Factory is to employ thirty men. S. K. Boyajian and a group of Boston men are behind the venture.

The Niagara Brass Co., Buffalo, N. Y., has suffered a \$5,000 fire loss.

The Acme Metal Mfg. Co. has moved its equipment from Chicago to Fort Madison, Iowa. Oswald Koll is the superintendent.

The strike at the H. A. Matthews Mfg. Co., Seymour, Conn., has been settled under a compromise agreement of 7½ per cent increase in the wage.

Thomas H. Lee, O. B. Wren and Thomas Robinson, all of New York, have organized the Empire Metal Products Corporation (Delaware), with \$500,000 capital.

It is said the C. E. Sanders Process Co., a concern that has moved from Detroit to Passaic, N. J., is preparing to make the brass parts of munitions.

Aluminum shapes to fit all parts of the human body, pierced with channels for hot or cold water circulation, have been invented by a Viennese surgeon for use as surgical compresses.

Waterbury (Conn.) Metal Wares Co. starts business with \$2,425 capital. L. W. Anderson is the president.

The California Metal Trades Association has agreed to an increase of wages of 25 cents per day, with the same amount as an increase operative in December.

A rich find of mineral has been found in the Silver Lake region near Fowler, N. Y. It is nickel ore, also cobalt that runs about \$100 per ton.

E. W. Kerrihard of Red Oak, Iowa, has been elected president of the National Association of Sheet Metal Products Manufacturers at the fifth annual convention of the body. The other officers are: Vice-presidents, Charles R. Butler, Kansas City, Mo.; Alex Bruce, Fargo, N. D.; D. C. Dempster, Beatrice,

Neb.; treasurer, C. A. Kramer, Kansas City, Mo.; secretary, Howard B. Kelley, Waterloo, Iowa.

The estate of Charles M. Hall, father of the aluminum industry in this country, and late vice-president of the Aluminum Company of America, amounts to a little less than \$10,000,000, according to an inventory.

The American Graphophone Co., Bridgeport, Conn., is building an addition to its boilerhouse on Railroad Avenue.

The Scovill Mfg. Company, Waterbury, Conn., is running to full capacity on its regular domestic business in brass goods, and with its increased capacity is taking care of large orders for shrapnel caps and fuses.

The American Locomotive Headlight Company will build a factory in Evansville, according to a statement of one of its representatives.

The American Cupro Nickel Company, a new company in Stamford, Conn., is reported to have awarded contracts for a rolling mill, 112 x 180 ft., and a casting shop, 45 x 125 ft.

The Twin City Four Wheel Drive Company, St. Paul, Minn., is building a factory in University Avenue to cost \$51,000.

The Buick Motor Company, Flint, Mich., has announced that it will erect a new foundry, 300 x 530 ft., two stories.

The Ellison Brass Mfg. Company, Falconer, N. Y., has completed plans for a brass foundry, 50 x 100 ft., of concrete construction.

The Aluminum Products Company, Bloomington, Ill., will erect an addition, 54 x 70 ft., of steel and glass, with concrete foundation, to cost about \$15,000. It will also build a power house.

The Brockway Motor Truck Company, Binghamton, N. Y., has purchased an acre of land, adjoining its present plant, and has started the construction of a building 40 x 186 ft., and will erect a second building in the spring, both of concrete, to be used for the manufacture of motor fire trucks.

The Acme Shear Company, Bridgeport, Conn., is another shear manufacturer which is reported to be adding to its plant, 46 x 63 ft., one story.

Trade Opportunities

The names and addresses of subscribers who have sent in any of the following inquiries will be furnished to any of our advertisers on application.

Chemicals for Enameling Cast Iron Enameling Ovens

We wish to get the names of firms in the United States who handle the necessary chemicals for porcelain enameling on cast iron. Also a description of the enameling ovens and the names of the manufacturers. We are particularly interested in equipment for the smaller size of ovens.

Nickel Salts—"Bo-Nic"

We have on hand in our laboratory a sample of nickel salts sent to us under the trade name of "Bo-Nic." Since we are desirous of making test of this material and being unable to locate the name of the manufacturer, we would enlist your services, and trust that you can advise us who makes this class of salts.

Soft Solder

Will you kindly give us the name of a firm selling soft solder which will flow in hot water?

Aluminum Bronze

We note in your November issue, page 455, an article on Aluminum Bronze and that this is less expensive than ordinary metals. Will you kindly advise us from whom we can secure this metal?

Die Casting Machine

We would like to find out through you where we could get figures and details in regard to a die casting machine, both air and plunger machines.

Machine for Valve Bodies

We have an inquiry from one of our Australian connections who are subscribers to your publication, and who ask us to give them particulars of the best American valve body machine and the sizes handled, and we shall feel greatly obliged if you will give us the benefit of any information you may have on this subject.

Metals, Etc.

Will you kindly advise us the addresses of dealers in the following material: Powdered Magnesium, Powdered Anti-

mony, Antimony Metal, Rosin suitable for filling shrapnel cases?

Automatic Polishing and Buffing Machines

Do you happen to know of any concerns that manufacture automatic polishing and buffing machines for small brass shells?

Material for Lining Plating Tanks

Please advise where I can get material for lining plating tanks.

Machine for Making Zinc Rods; Zinc Shaving Machine

Can you inform us relative to a machine for making zinc rods, and also relative to a zinc shaving machine? Our idea was to use these in connection with refining spelter.

Furnace

Please give us the names of some firms we can correspond with who manufacture furnaces, either oil-burning, electric, gas, or coal, for melting and using in a shop to cast lead and antimony and Britannia metal. We want one with a capacity of 500 lb. or possibly a little larger.

Foundry Stove

Please advise where I can buy a stove or oven such as used in all foundries for drying cores, etc., one using coal, not gas. The stove I want is an ordinary square-shaped oven or stove which comes in sections and can be put together to any height. It has a platform at the bottom for the molds to stand.

The descriptive bulletins issued by the Munning-Loeb Company of Matawan, N. J., are not simply trade catalogs of the goods made and sold. They contain much of practical interest to the plater.

Bulletin 700 on buffing, polishing and burnishing machinery, the latest of the series of publications on electro-plating and polishing equipment and supplies, fully describes the line of buffing and polishing lathes from the small bench lathes to the large double spindle pedestal lathe, also belt strapping machines, flexible grinders, tumbling barrels, burnishing barrels and sand-blast apparatus. This bulletin will be sent to anyone on request in addition to any of their former publications.

Economy of Metal Cyanides

The Roessler & Hasslacher Chemical Co. has a 12-pp. pamphlet that platers ought to read. The argument is to demonstrate the value of the C. P. cyanides of copper, zinc and silver over impure salts like copper and zinc carbonates and silver chlorides. The metal cyanides place at the disposal of the plater pure and highly concentrated metal salts free from inert matter of every kind. By their use he is able to introduce a maximum amount of metal into his solution and still have a solution of low specific gravity. He has only two factors to contend with—metal and cyanide—having eliminated the inert matter of doubtful nature. If the solution requires metal, he can add it by the addition of the metal cyanides, and when the solution becomes deficient in cyanide he can add it in the form of sodium cyanide. The solution remains balanced indefinitely. In adopting the metal cyanides, the plater does not have to discard his old solutions; they can also be used for replenishing old solutions no matter with what salt originally installed.

The price of the metal cyanides may seem too expensive, but it does not work out so. We quote the pamphlet:

"The cost of putting in solution 100 lb. of copper carbonate 50 per cent, with sufficient free cyanide to obtain a deposit, is as follows: 100 lb. copper carbonate, at 18½c. per pound, \$18.50; 200 lb. sodium cyanide, 129 per cent, at 26c. per pound, \$52. Total, \$70.50.

"Such a solution would contain 50 lb. of metallic copper. To put in solution the same amount of metal in the form of copper cyanide the plater requires 71¼ lb. of copper cyanide which requires a like amount of sodium cyanide, 129 per cent, to obtain a bath with sufficient free cyanide for immediate results. The cost would be: 71¼ lb. copper cyanide, at 45c. per pound, \$32.06; 71¼ lb. sodium cyanide, 129 per cent, at 26c. per pound, \$18.52. Total, \$50.58.

"Thus, the plater, with the metal cyanides, obtains a solution containing the same amount of metal, low in specific gravity, at a saving of over 25 per cent."

We find in the pamphlet the following formulas that will interest platers:

COPPER SOLUTION

Water	1 gal.
Sodium cyanide, 129% ..	3½ ozs.
Copper cyanide	3 ozs.
Soda ash	½ oz.

Such a solution worked at a normal temperature at 3 volts will give excellent results. To make up a new solution fill the tank with water and in a separate crock dissolve the above ingredients in about ⅓ the total amount of water which has been previously heated. After the salts are all dissolved, add this concentrated solution to the water in the main tank.

For replenishing solutions, dissolve equal parts of sodium cyanide, 129 per cent and copper cyanide in a small quantity of water heated to about 180 deg. F. When the same is all dissolved, add this to the solution that is to be replenished.

The above instructions also apply to the following solutions:

BRASS SOLUTION

Water	1 gal.
Sodium cyanide, 129% ..	4½ ozs.
Copper cyanide	3 ozs.
Zinc cyanide	1 oz.
Ammonium chloride ...	⅓ oz.
Soda ash	1 oz.

ZINC SOLUTION

Water	1 gal.
Sodium cyanide, 129% ..	4 ozs.
Zinc cyanide	6 ozs.
Ammonium chloride ...	2 ozs.

SILVER SOLUTION

Water	1 gal.
Sodium cyanide, 129% ..	3½ ozs.
Silver cyanide	2½ ozs.
Ammonium chloride ...	⅓ oz.

The proportions given in the above recipes can be increased or decreased according to the special requirements and the metal content required for certain work.

Forty years ago aluminum was as much a chemical curiosity as any of the rare metals of to-day, although it is one of the most widely distributed metals on earth as it forms the basis of the most common rocks, and is the chief constituent of most clays.

American Crucible Clays

To determine whether American clays could be used in the manufacture of crucibles, glass pots and other fire resisting wares, to replace the foreign clays hitherto considered indispensable, the Department of Commerce was appealed to by American producers of clays with the result that the following statement was prepared by Prof. A. V. Bleining, ceramic chemist in charge of the Clay Products Section of the Bureau of Standards, and for which we are indebted to Commerce Reports.

In the manufacture of glass pots, tank blocks, graphite crucibles and similar refractories a certain amount of plastic clay is required for the purpose of bonding together the grains of calcined material ground potsherds, and previously burned fire clay, which constitute from 50 to 60 per cent of the mixture used. The requirements of pot clays are very exacting and may be summarized as follows: First, sufficient refractoriness to withstand the high heat of the furnaces, under the pressure of the liquid charge, without showing deformation; second, great plasticity and bonding power, making possible the cementing together of the grains of calcined material to a compact mass; third, possession of considerable mechanical strength, especially in the dried state; fourth, the quality of becoming dense at comparatively low temperatures in order to produce a structure impervious to the liquid glass or metal and resisting their corroding influence; fifth, the property of retaining a sound structure, free from vesicular development, upon long continued heating; sixth, the quality of drying and firing safely without cracking or checking.

These requirements are very severe and are possessed by very few clays. The materials which have been found most satisfactory by years of practical experience are a number of European clays, principally those from Gross Almerode, Klingenberg, Schippach, and the Westerwald district in Germany, and from Belforce and the Ardennes region in Belgium. These clays possess the properties demanded of glass refractories to a remarkable degree. Still it has been found possible for a number of years to use in many places a mixture composed of a larger quantity of American plastic clay from Missouri (St. Louis) and

a smaller quantity of the imported clay with satisfactory results.

During the first six months of the war the supply of European glass-pot clays was fairly regular, but shipping conditions have become very much more difficult at the present time, and as a result the demand for these materials can not be satisfied. This condition is an embarrassing one for the glass and the crucible industries, and the question of replacing the foreign clays by American materials must receive immediate attention. A review of the situation tells us that the case is not as hopeless as it has been represented to be by some, and the cessation of the clay imports certainly can not be said to have a disastrous effect on the industries involved. The use of domestic clays already known will enable manufacturers to continue operations; although it is quite possible that until the best possible mixtures of clays can be worked out the production cost will be increased, due to the shorter life of the glass pots and crucibles. In the end the necessity of using domestic clays, which are cheaper and more easily obtained, would be a distinct benefit to the industries.

Recent tests of American plastic fire clays have shown that some of these approach the imported clays in quality, but are still lacking in one or another respect. No single American clay so far examined has been found to be a perfect substitute for the gross almerode and related clays, even though it may be superior in some of its properties. It is, however, not improbable that such a material may be found sooner or later. This condition need not be at all discouraging, since the problem can be solved by the use of a mixture of several American clays, each of which contributes its share toward the development of a suitable structure. The deficiencies of any one clay may thus be compensated for by the others.

This practice has been followed by the German pot makers with good success, and in some compositions as many as six clays are being used. A further advantage gained in this way is the fact that natural variations in composition and properties which occur in practically all clay deposits do not become so important as when only one material is used, for it is improbable that all clays should change in the same direction at the same time.

Owing to the fact that American manufacturers have already acquired an extensive experience in the use of the Missouri plastic fire clays which have been found to be valuable glass-pot materials it should not be a difficult task to supplement them with certain other clays which are available. It can not be expected that pots and crucibles of the highest quality can at once be manufactured. The experience being gained must be paid for during the period of development by the possible shorter life of the pots and unavoidable accidental defects which are apt to occur until the best possible proportions have been established. This is a temporary condition which can hardly be avoided. It is important at the same time that close co-operation between the glass manufacturers and the makers of pots be maintained and that systematic research be supported akin to the practice prevailing in the German industries. The prejudice to experimental work now existing in the industries under discussion should be overcome.

With reference to the sources of plastic fire clay in the United States, there are available, besides the Missouri clays, very strong and refractory ball clays in Tennessee and Kentucky, more siliceous but exceedingly plastic materials in Arkansas, excellent soft fire clays in Pennsylvania and southern Ohio, several ball clay-like deposits in southern Illinois, and the various plastic refractory materials of New Jersey. These clays represent a considerable range of properties, and when suitably combined should give results closely approaching those obtained by the use of the European clays.

There might be added that artificial improvement in such physical properties as plasticity, bonding power, shrinkage, strength in the dry state, etc., is not at all impossible through the use of small quantities of reagents like tannic acid and other organic substances as well as inorganic salts, procedures which have been pointed out in recent experimental work.

In concluding this discussion the situation might be summarized by stating that the lack of imported pot and crucible clays can by no means be called an industrial disaster and their replacement would offer no grave difficulties.

The wastes in zinc mining and smelting

constitute a heavy drain. Less than 50 per cent of the zinc in the mines ever reaches the form of spelter.

Spelter Production for First Six Months of 1915

The production of spelter for the first six months of the year has been canvassed by the U. S. Geological Survey, with the following results expressed in short tons:

The output of spelter was 207,634 tons made from domestic ores and 8898 tons from foreign ores, a total of 216,532 tons, as compared with 177,991 tons for the preceding six months and with 175,058 tons for the first six months of 1914. In addition there was produced by distillation from drosses and skimmings 13,546 tons of secondary spelter, as compared with 10,273 tons, the half of the 1914 output of distilled secondary spelter. No statistics were obtained of the spelter produced by remelting skimmings, drosses, etc., but it was probably not less than 12,000 tons. The total output of spelter from both ore and skimmings was therefore about 242,000 tons, or at the rate of 484,000 tons per year. The whole number of retorts in operation in June was about 127,000, but many of these retorts had been but recently put in operation. Additional retorts to the number of over 32,000 have since been completed, are under construction, or are planned.

The apparent domestic consumption for the six-months period was 160,906 tons, as against 149,762 tons in the preceding six months and 149,306 tons in the first six months of 1914. The spelter stocks on hand at smelters were 5884 tons, an average of about 150 tons each for the plants reporting.

According to observations made during the course of research work for an Eastern optical company, it was found that more than 90 per cent of the colored glass used to safeguard the eyes of industrial workers, who are subjected to violet rays and intense light, is injurious. Measurements of the absorptive qualities of certain kinds of glass were made, with light sources varying in temperature from 2000 deg. F. to approximately 6400 deg. F. It was shown by these tests that cobalt-blue glass, red, green and smoked glasses do not intercept harmful rays to the extent desired in many fields in which they are used.—Popular Mechanics.

Production, Consumption, Stocks

Figures compiled by C. E. Siebenthal, of the U. S. Geological Survey, from reports by all zinc smelters operating during the first six months of 1915 show that the production of spelter from domestic ore in that period was 207,634 short tons and from foreign ore 8898 short tons, a total production of 216,532 tons, compared with 177,991 tons for the last half of 1914 and 175,058 tons for the first half. The spelter made in Illinois increased about 9000 tons, that made in Kansas increased about 15,000 tons, a larger increase than was shown by any other State, and that made in Oklahoma increased about 5000 tons, compared with the spelter made in those States during the last six months of 1914. The stock of spelter held at smelters on June 30, 1915, was 5884 tons, against 20,095 tons at the beginning of the year and 64,039 tons at the middle of 1914.

From the foregoing figures and the records of the Bureau of Foreign and Domestic Commerce it is calculated that the apparent consumption for the period was 160,906 tons, which compares favorably with 149,813 tons for the last half of 1914 and 149,312 tons for the first half. This consumption was not altogether domestic, however, for it must include the zinc content of the exports of brass and brass articles, which were increased during the first half of the year.

Zinc continues to advance. It is stated that the Butte & Superior mine has sold 2,500,000 pounds of spelter at 13 cents, delivery to be made at the rate of 500,000 pounds per month for five months. The American Zinc, Lead & Smelting Company has sold 3,500,000 pounds on forward delivery, the prices being astonishing, namely, 900,000 pounds ordinary brass spelter at 16¼ cents, 2,100,000 pounds intermediate spelter at 19 cents, and 500,000 pounds of highest grade at 20 cents per pound.

The Ancient Salt Dish

Among the chief ornamental pieces on the tables of all those who occupied the highest ranks were for a very long time the salt dishes. These were often real works of art wrought of gold and silver by the greatest masters of their period. The famous Benvenuto Cellini made for King Francis I. of

France a salt cellar of gold, which is now considered one of the most precious possessions of the Imperial Gallery at Vienna. The invention of silver plating and the use of various metal alloys have rendered the most elegant table services less costly.—Jewelers' Circular.

Machine for Cutting Off Copper Bands

The Automatic Machine Company, has brought out a machine for cutting the copper bands used on shrapnel and high explosive shells. Two sizes are built, the smaller for handling work having a maximum diameter of 3¾ in., while the capacity of the other is 3 in. greater. The essential feature of the machine is the use of a large cast-iron hollow spindle with a spring collet chuck and spring feeding fingers which extend almost to the back of the tube holding chuck. In addition to cutting off the copper bands, the machine by being slightly modified can also be employed for trimming either end of the shells, for finish turning the bands, for cutting steel tubing and other classes of work where a large hollow spindle with a spring collet chuck can be used.

Zinc in water, either fresh or salt, protects iron and is itself attacked, so if iron and copper are immersed in a liquid capable of acting on each, and connected by a conductor, a current will pass from the copper to the iron, and the iron will be dissolved. And yet, after a series of exhaustive experiments, Mr. Richard H. Gaines states:

The legitimate conclusion from the foregoing experiments is, that rather less than more galvanic action arises from contact between steel and the other metals of the series, than from contact between steel and steel. In actual practice it has been found that if a steel nut is put on a steel bolt and subjected to corrosive conditions, in a comparatively short time the steel nut will have to be split off, if gotten off at all, on account of rusting together; whereas a brass or bronze nut on a steel bolt under similar conditions can be readily screwed off.

The type of carelessness which results in inaccurate work is very common and it is not altogether confined to the operator who is responsible for the production, although he frequently has a hand in it.

CLASSIFIED ADVERTISEMENTS

Advertisements for Situations Wanted, not exceeding 75 words, published free of charge for subscribers. Help Wanted and For Sale advertisements—one dollar per inch, single insertion; three insertions for two dollars

For Sale

SMALL electroplating outfit used two months. Address Box 9, care of Brass World, Edison Bldg., New York.

FOR SALE—Complete set of transactions of American Institute of Mining Engineers covering years 1893 to 1912, in first class condition at a special low price. Address Box 1137, Brass World, Edison Bldg., New York City.

FOR SALE—Lot of used Union canvas, Bullneck, felt and compressed wheels, loose buffs, brass and copper anodes. Write for complete list. 609 Chouteau Ave., St. Louis, Mo.

FOR SALE—Large, modern job plating plant, established 21 years. Cleared better than \$4,000 this year. Will sell at invoice (about \$4,000). Good reason for selling. Chance of a lifetime. D. B. H., 215 E. 11th St., Indianapolis, Ind.

FOR SALE—Modern equipped polishing and plating plant centrally located in busy Detroit. Have operated this plant successfully for four years. Other business opportunities demand entire attention. Address Rex Jobbing Co., 64 Second Ave., Detroit, Mich.

Bone and Ivory Chips Wanted

WANTED—Bone and ivory chips or dust, waste of manufactured articles of bone and ivory. Send prices and samples, also quantities produced. Will pay cash for the right materials. Address Box 14, Brass World, Edison Bldg., New York.

Help Wanted

SALESMAN—Concern in the West making plating and tumbling machinery and selling plating supplies, wants first-class salesman for the Eastern territory. Must be a practical plater and able to demonstrate the apparatus. Address

Box 501, Brass World, Edison Bldg., New York.

WANTED—Experienced man, thoroughly efficient in the resmelting of aluminum, brass and copper scrap, and the mixing of alloys. Address R. L. M., Box 1241, Brass World, Edison Bldg., New York. Communications considered confidential.

Situations Wanted

FOREMAN—Have had twenty years' practical experience in polishing, grinding, buffing, coloring, relieving brass, steel, etc., by hand or machine. Work of all kinds, sheet metal, castings of all shapes. Can make chucks, polishing wheels or straps, estimate, etc. Want position as foreman or assistant. References. Address Box 1240, BRASS WORLD, Edison Bldg., New York.

SALESMAN—Familiar with chemicals, supplies, specialties, or anything in related lines in metal working trades or manufactured goods. Experienced and now in responsible position. Good references; practical plater with chemical education. Box 1242, Brass World, Edison Bldg., New York City.

FRENCH MOULDER — Ex-foreman large art bronze foundry in Paris desires position. Can accomplish rapidly the most difficult work. Will take contract, if desired; also thoroughly experienced in gold and silver work. Speaks little English. Address Box 1135, Brass World, Edison Bldg., New York.

EXPERIENCED FOREMAN PLATER—Desires situation. Understands plating, polishing, lacquering, oxidizing. Can also work barrel plating, ball burnishing, and all kinds of tumbling. Member Am. Soc. Electro-Platers. Address Box 1136, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Wants to change position. Best references, 19 years' experience. Can handle all usual work in all metals, also stove, plumbing supplies, trunk hardware and jobbing work. Can handle workmen, day or piece work. Am at present in charge of 3 departments. Address Box 1134, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Who needs a foreman plater of seventeen years' actual experience in all popular finishes in gold, silver, nickel, copper, brass, bronze, tin, lead? Who has hardware that must be produced economically? Who has something hard to do in the plating line and is willing to back up a competent man in fitting up a plant to defy competition? Who has die-castings to plate in any metal with not more than five per cent loss? I will take your hardest proposition, and if it can be done I will do it. I am for sale. Address Box 1031, Brass World, Edison Bldg., New York.

POSITION WANTED by a first-class brass foundryman, experienced in plumbers' supplies, valve work, builders' hardware and general jobbing. Address Box 1032, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Nineteen years' experience as plater, polisher, buffer, lacquerer and japanner; also good knowledge of chemistry. Am open for a position; can handle men to employer's advantage. Experienced in working on every solution known to the trade. Best results guaranteed. Will go anywhere in the United States. Best of references. Address Box 1030, Brass World, Edison Bldg., New York.

NICKEL PLATER—Over 20 years' practical experience in plating, polishing and buffing. At present occupied, but desires position with manufacturing plant as superintendent; or foreman of the above-named departments; best of references. Address Box 1028, Brass World, Edison Bldg., New York.

PLATER—A No. 1, steady and reliable; have a broad experience with a large variety of work, including on nickel, brass, copper, bronze and zinc, and a

little silver and gold plating. Tinning; all kinds of oxidizing and lacquering. At present employed. Would make a change to good, reliable concern. Can handle piece or day work help to advantage. Address Box 1025, Brass World, Edison Bldg., New York.

MOLDMAKER—Twenty years' experience in designing and modeling trimmings for britannia hollow ware, chasing and fitting molds and dies; A1 on toilet ware, dies and forces. Address Box 1027, Brass World, Edison Bldg., New York.

PLATER—I understand plating, polishing, buffing, lacquering and oxidizing of all metals. Can also nickel plate sheet zinc and castings. Address Box 926, Brass World, Edison Bldg., New York.

PLATER—Married; fourteen years' experience at all finishes, gold, silver, nickel, copper, brass, bronze, oxidizing, etc.; make all solutions. Have had wide experience on various articles of manufacture. Steady and sober; quick worker. Will leave city, if permanent position. Address Box 922, Brass World, Edison Bldg., New York.

PRACTICAL PLATER—Foreman plater with electrochemical knowledge desires to connect with a reliable firm where his knowledge would be useful. At present employed as foreman of a plating, polishing and finishing department. Want to make change. Address Box 918, Brass World, Edison Bldg., New York.

FOREMAN PLATER—Have twenty-two years' experience; can take charge of polishing and buffing departments; have good references; thoroughly up-to-date on all solutions and finishes; mechanical plating and polishing barrels; can handle help to advantage and show results. Address Box 921, Brass World, Edison Bldg., New York.

BRASS FOUNDRY FOREMAN—Wanted position as foreman or assistant in brass or aluminum foundry. Familiar with metal mixing machines and all up-to-date methods of molding. Wide experience; good references. Address Box 15, Brass World, Edison Bldg., New York.

Current Metal and Supply Prices

A Review of Metals

In reviewing the old and new metal market for the past five weeks we recognize at once the immense prosperity that has come to the metal trade, and though fluctuations ran along throughout this period, the market has had such a boost that it could stand some reverses. In fact the speculator likes fluctuations, and metal dealers are "some" speculators. In the early part of November a movement began to put copper higher and this was highly successful; beginning around 18c. for the new copper metal until it was gradually advanced during the five weeks to 20c. and even fractionally higher. Tin had a sharp advance and spelter started upward. Business bettered, prices of nearly every article in new and old metals kept advancing until about the middle of November; a veritable boom permeated the metal trade both new and old. But be it noted that up to the 15th November copper did not seem affected, but remained pegged until then, when it commenced to bestir itself, knocked off its pegs, and up it went to the high figure. Tin had a great jump and spelter advanced in a lively fashion. Aluminum reached the highest hitherto known since the article has become a staple; lead was advanced, and the export trade expanded.

On or about Nov. 22, tin had a sharp break, all other metals keeping onward. The mental attitude of the metal dealer was one of extreme optimism and bullishness, and under this influence activity increased. It must be noted here that the old and the new methods are so closely intertwined that the path of the old almost always parallels the new, with here and there an exception. Thus, as copper advanced, the copper scraps followed suit, the composition scraps, likewise the brass scrap. An exception there was in the brass turnings at this time, which became very much neglected and depressed, though spelter (zinc) which forms $\frac{1}{3}$ of brass, usually, has resumed, after a weak spell, its upward path. The week of Nov. 29, aluminum again bore the banner for activity and value. Spelter was a fair second. The depression noted in brass turnings continued. Local consumption bettered visibly, as could be seen by the greater demand for scrap like crucibled copper composition of heavy brass scraps, used by the domestic brass foundries. Export business had also increased.

In the last month of the year we already notice irregularity and halting in activity, features usual as we approach New Year and stock-taking time. Bullishness has abated. Sharp downward fluctuations in tin and spelter have occurred, especially in the latter. Slight recessions in copper, new and old. Zinc scraps became entirely neglected. There was resumption, however, of the new sheet brass scrap, for export shipment. During the month the long neglected German silver scraps had a burst of activity, but very shortlived. The metal trade, old and new, has cause to be satisfied, and continued prosperity is expected.

Old Metals

We quote dealers' buying prices for scrap metals:

Crucible copper	16 $\frac{1}{4}$ -16 $\frac{1}{2}$
Crucibled heavy copper	15 $\frac{1}{4}$ -15 $\frac{1}{2}$
Light copper	13-13 $\frac{1}{2}$
Heavy yellow brass	10-10 $\frac{1}{2}$
Light brass	8-8 $\frac{1}{2}$
Machinery composition scrap	12 $\frac{1}{4}$ -12 $\frac{3}{4}$
Good quality brass turnings	10 $\frac{3}{4}$ -11 $\frac{1}{4}$
Good quality red turnings	11 $\frac{1}{4}$ -12
Number 1 pewter	25-25
Old scrap zinc	9 $\frac{1}{2}$ -10
Old scrap lead	45-60
Electrotype scrap	4 $\frac{1}{2}$ -4 $\frac{3}{4}$
Stereotype scrap	6 $\frac{1}{4}$ -6 $\frac{1}{2}$

CHEMICALS

Acetone, pure, 98-99 per cent.	.45 lb.
Acid, acetic, pure 30 per cent.	.15 lb.
Acid, arsenious (white arsenic)	.10 lb.
Acid, boracic (boric), pure	.20 lb.
Acid, hydrofluoric, 48 per cent.	.40 lb.

Acid, muriatic, 20 deg.	.02 $\frac{1}{2}$ lb.
Acid, muriatic, c. p., 20 deg.	.07 $\frac{1}{2}$ lb.
Acid, nitric, 38 deg.	.05 $\frac{3}{4}$ lb.
Acid, nitric, 40 deg.	.06 lb.
Acid, nitric, 42 deg.	.09 $\frac{1}{4}$ lb.
Acid, nitric, c. p.	.10 lb.
Acid, sulphuric, 66 deg.	.02 $\frac{1}{2}$ lb.
Acid, sulphuric, c. p.	.07 $\frac{1}{2}$ lb.
Alcohol, wood	.55 gal.
Alcohol, denatured	.63 gal.
Alum, burnt and powdered, technical.	.20 lb.
Alum, commercial	.06 lb.
Ammonium sulphate	.05 lb.
Ammonia water (aqua-ammonia), 26 deg.	.06 lb.
Ammonia water, c. p.	.15 lb.
Ammonium carbonate, lump, C. P.	.15 lb.
Ammonium chloride (sal-ammoniac)	.16 lb.
Ammonium hydrosulphuret	.25 lb.
Ammonium sulphate	.09 lb.
Amyl acetate	lb.
Antimony (fine powder)	lb.
Arsenic, metallic	lb.
Arsenic, white (acid arsenious)	.10 lb.
Bismuth, metallic	3.00 lb.
Blue-vitriol	.12 lb.
Borax, crystals or powdered	.15 lb.
Borax, powd., refined, bbl.	.07 $\frac{1}{4}$ lb.
Borax, lump, refined, bbl.	.07 $\frac{1}{2}$ lb.
Borax glass	.30 lb.
Carbon bisulphide	.20 lb.
Calcium carbonate (precipitated chalk)	.10 lb.
Chrome-green, c. p.	lb.
Cobalt, metallic, pure and carbon free.	3.00 lb.
Cobalt, black peroxide	1.95 lb.
Copper carbonate, dry	.30 lb.
Copper, sulphate (blue-stone)	.12 lb.
Copper trisalyt	.30 lb.
Copper cyanide (technical)	1.00 lb.
Cyanide, see Potassium cyanide	.40 lb.
Dextrin	.15 lb.
Emery flour	.05 lb.
Emery, F F & F F F	.03 lb.
Flint, powdered	25.00 ton
Fluorspar	30.00 ton
Fusel-oil	4.50 gal.
Gold chloride	11.75 oz.
Gold trisalyt	10.00 oz.
Iron perchloride (110 lb.)	.20 lb.
Iron sulphate (copperas)	.05 lb.
Lead acetate (sugar of lead)	.20 lb.
Lead, red (pure)	.15 lb.
Lead, yellow oxide (litharge)	.15 lb.
Nickel and ammonium sulphate (double salts), 100 lb.	.14 lb.
Nickel carbonate, dry	.70 lb.
Nickel, metallic	.60 lb.
Nickel sulphate (single salts)	.20 lb.
Nitre (saltpetre), see Potassium nitrate.	
Oil of vitriol, see Acid, sulphuric.	
Paraffin, high viscosity	.15 lb.
Phosphorus	.05 lb.
Pitch	.05 lb.
Plaster of Paris, dental	.05 lb.
Potassium bicarbonate, c. p.	lb.
Potassium carbonate	lb.
Potassium cyanide chloride mixture	lb.
Potassium iodide	lb.
Potassium permanganate	lb.
Potassium, red prussiate	lb.
Potassium sulphate (liver of sulphur)	lb.
Pumice, ground	.05 lb.
Rochelle salts, U. S. P.	.40 lb.
Rosin, yellow	.03 lb.
Silver chloride, dry	.65 oz.
Silver cyanide	1.00 oz.
Silver nitrate, crystals	.45 oz.
Silver trisalyt	lb.
Soda-ash	.05 lb.
Sodium bisulphite	.01 $\frac{1}{4}$ lb.
Sodium carbonate (sal-soda), crystals	.01 lb.
Sodium hyposulphite ("hypo")	.05 lb.
Sodium nitrate (technical)	.10 lb.
Sodium phosphate (technical)	.09 lb.
Sodium silicate (water-glass)	.05 lb.
Tin chloride	.43 lb.
Turpentine, spirits of, U. S. P.	1.00 gal.
Wax, beeswax, yellow	.37 lb.
Wax, carnauba	.45 @
Whiting (ground chalk)	.05 lb.
Zinc, carbonate, dry	.30 lb.
Zinc, chloride	.20 lb.
Zinc, cyanide	1.00 lb.
Zinc sulphate (technical)	.12 lb.

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